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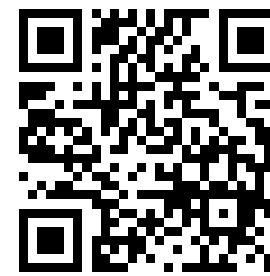

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A

MONTHLY ILLUSTRATED JOURNAL OF SCIENCE.

EDITED BY

A. NORMAN TATE,

F.I.C., F.C.S., F.G.S., F.R.M.S., &c.

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NOTICES.

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Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

NOTE.—In our next issue, an interesting paper on the "Bugle Coralline," by Mr. J. Lomas, will appear, for which special illustrations are being engraved; also articles on the "Manchester Technical School," "Geological Rambles," &c , &c.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following number, should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Our Programme.

WE wish in our pages to report the results of scientific inquiries, and stimulate further research. There are many workers in the fields of science. On the one hand, we have those, who, with definite objects in view, approach and conduct their work in a thoroughly scientific manner, and the outcome of their work adds greatly to our knowledge and progress. On the other hand, there is a large number of workers, who, although showing great industry, proceed with no very definite aim beyond that of indulging in pleasant occupation, but the work these do is not unfrequently valuable in corroborating the results obtained by others, and bringing to light new facts.

Bearing all this in mind, we think, notwithstanding the many journals devoted to science that now exist, that some good may be done by a paper specially intended to stimulate steady systematic scientific research:

First.—By putting before our readers a careful digest of what has been and is being accomplished by workers of the first order, so that it may serve as a stimulus to others who desire to work thoroughly also.

Second.—By endeavouring to show what is the special value and bearing, scientifically and practically, of this knowledge.

Third.—By pointing out how such work may be supplemented; and also by indicating new lines of inquiry.

Fourth.—By communicating as far as practicable the results of these further investigations.

In trying to carry out these objects, we shall, as regards the first, strive to give intelligence of the latest discoveries made and progress effected in all the various branches of modern scientific inquiry, and information respecting recent applications of science to the arts, manufactures, and industrial pursuits; also a *resumé* of the more important work of the numerous scientific societies of this kingdom, and of the leading foreign societies. There is a vast amount of work accomplished by the members of the many different societies in this country and elsewhere, the results of which are known only within limited circles; and many societies do not even publish their transactions. As far as it lies in our power we shall endeavour to gather and report all that is most valuable in societies' proceedings. To do this as fully as possible, we invite the aid of secretaries, leaders

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of scientific excursions, and others who can officially communicate information. We shall also insert original communications, including leading articles and special memoirs on topics of scientific interest by writers well known for their special study of the subjects dealt with. These will include popular articles on topics probably already known to advanced students, but will be written so as to guide younger students in their work.

Then, as regards sources from which useful information can be obtained, in addition to reviews and notices of books and other literature, including mention of libraries to which access may be obtained, we shall give descriptions of museums and their contents. Many of the interesting and valuable objects in some of our museums too often remain unstudied for want of handy de criptions of them—indeed, many remain unnoticed, because there is no record of their existence, and in some measure we shall endeavour to supply the deficiency; and, as we strongly advocate the value of field work in many scientific studies, we shall also give descriptions of localities that present favourable opportunities for scientific field work for those interested in geology, botany, and other natural history subjects, together with special articles on the objects there to be noted.

In our endeavour to stimulate further research, we hope to make suggestions for further investigations a prominent feature of *Research*, and to those who may act upon such suggestions every possible opportunity will be afforded for recording the results obtained.

And, for the purpose of comparing notes and ventilating opinions, space will be afforded for discussions on scientific questions of current interest, and we shall always be glad to receive from Teachers of Science, Science Students, and all interested in scientific pursuits, communications on subjects open to scientific controversy.

No scientific journal can be complete in its programme unless there is included a careful record of the progress of scientific and technical education, and to this we shall give most careful attention.

One more feature we think will be of interest to our readers, viz.: the biographies and portraits of some of the representative men of science in different centres, and these we shall give occasionally as space and opportunity allow. We have much pleasure in giving in this our first number a portrait and short biography of one whose scientific work in many ways has been truly useful, and whose precepts and example have stimulated others to earnest profitable science work.

This, then, is the programme we shall endeavour to carry out, and we hope that in doing so we shall gain the confidence and support of a large circle of readers and scientific workers.

The Water Supply of Liverpool.—This has been lately curtailed to a supply in the City of Liverpool and Borough of Bootle, extending from twelve o'clock noon each day to six o'clock on the following morning, and, in the Suburban districts (other than Bootle), from twelve o'clock at noon until ten o'clock p.m. Such a curtailment can only be warranted by the extreme necessity of endeavouring to prevent a water famine. It is not only a great inconvenience, but a very serious matter in relation to the health of the city. A full and explicit report on all the circumstances that have led to this curtailment, the probable supply for the immediate future, and the date when the water supply of the city can be, under all circumstances, relied upon, should be demanded, and fully sifted when supplied. Especially should there be asked for a most searching inquiry into the present condition of the Vyrnwy works, and the arrangements for a temporary supply until these are ready. City councils and other governing bodies must be made to know that they cannot, except for very urgent reasons, so restrict the supply of one of the first necessaries of life without serious risks. But whilst saying this, we would strongly urge all the inhabitants of Liverpool to do their utmost to prevent waste, which is too frequently the result of individual negligence. One lesson which we hope the present scarcity will teach is that of the importance of a constant supply of good water, and the evils that may arise from reckless waste.

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It is about a year since the Puffin Island Biological Station was opened under the auspices of the Liverpool Marine Biological Committee. The report of Professor Herdman on the foundation and first year's work of this Association shows that the work so far done is of great value to naturalists in advancing our knowledge of marine life. Work has been again renewed, but funds are required to keep up the Station, and, according to a circular lately issued asking for the co-operation of all interested in the advancement and spread of the knowledge of our marine fauna, the working expenses are only about £100 per annum, and that annual subscriptions already promised amount to about £35. It is to be hoped that subscriptions to meet any deficiency will soon be forthcoming, for there can be no doubt that the investigations carried on by the committee must prove very valuable, not only from a strictly scientific point of view, but may aid much in solving other questions of practical importance.

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Field Geology.—A report of the excursions made during the summer of 1887 under the direction of Professor H. G. Seeley has been lately published, and shows how very valuable field work is to the geological student. The localities visited were Loam Pit Hill to examine the lower tertiary strata; Oxford Shotover Hill to study the neocomian sands, Portland oolite, Kimmeridge clay, coral rag, calcareous grit, and Oxford clay; Caterham Junction and Merstham to note

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the upper and lower chalk; Caterham and Godstone, where the chalk and upper greensand were observed; and Dunton Green to study the chalk, gault and lower greensand. The report gives a good description of the geological features noted and the work done, and is accompanied by several excellent lithographic sections. The class is again at work this year. It is very desirable that work of this kind should be more extensively carried on, as it is quite impossible that lectures in the ordinary class rooms can teach all that is necessary to be learned in geological science, for much that should be known can be more fully studied out of doors. In Liverpool, a similar class has been organized in connection with the Liverpool Science and Art Classes by Mr Daniel Clague, whose students meet on Saturday afternoons and visit places where they can fully study the geology of Liverpool and neighbourhood This class is in connection with lectures given by Mr. Clague during the summer months on palæontology and mineralogy.

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Field Botany.—In connection with the same institution, Mr. H. Leaton Edwards, F.I.C., is teaching botany this summer, and part of his programme is to frequently take his students for practical work into the Botanical Gardens, fields, &c More field work than is now given in ordinary botanical teaching is very necessary. There are two classes of botanical students now-a-days, one undergoing study in the ordinary lecture-room without sufficient opportunity of noting plants as they live in the fields, hedge-rows, and under other natural conditions; and the other often to be found amongst those who attend the field meetings of botanical clubs and naturalists' societies, who know many plants and the classes, orders, &c., they belong to, but who have had no real training in botanical science. Both classes lose many of the pleasures derivable from botanical study. We certainly wish to see a more general adoption of field-work in connection with botanical lectures and ordinary class work.

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The Yorkshire College.—The Fourteenth Annual Exhibition of Textile Patterns and Designs was opened on the 22nd of June, in the Museum of the Textile Department. All the patterns shown have been produced by the Students during the session 1887 and 1888, in the looms of the department, and include various classes of woollen, worsted, silk and cotton textures. The classes represented comprise three evening and three day courses. Amongst the many examples shown, are designs for mantlings, patterns for figure trimmings, designs in fancy vestings and figure woollens, woollen, worsted and other shawls woven at the College, and many other pieces of work. Fabrics for trousers, coatings, mantlings and dresses in wool, worsted, silk, cotton, and other materials are also shown. Lately, a new plant of finishing machinery has been added to that already existing at the College, and includes machines for scouring, milling, and raising and finishing the various fabrics made in the looms of the College. As having reference to technical education, the exhibition is of much value, and shows that the practical teaching given at the College can aid greatly in training those engaged in the trade of the district.

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Examinations in Microscopy.—In connection with the St. Louis College of Pharmacy there has been passed by the graduate class an examination in microscopy, which, says the American *National Druggist*, "is a model of its kind." The use of the microscope has become so very important in analytical and technical work and scientific research that it would be well if the value of courses of study and examinations in the use of the microscope were more generally recognised and insisted on. We hope to refer more fully to this subject in future issues.

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Electric Lighting.—All who are desirous that the progress of Electric Lighting shall not be hampered by unnecessary restrictions, of which there are already far too many, will be pleased to note the decision of Vice-Chancellor Sir H. F. Bristowe in the Chancery Court in the County Palatine of Lancaster, in the motion of Pierce *v.* The Liverpool Electric Supply Company, Limited, in which an injunction was sought to restrain the Company from working their engines and machines at their Supply Station in Tithebarn Street in such a manner as to annoy the plaintiff, who is an emigration agent and hotel proprietor, carrying on business adjacent to those of the Company. After hearing evidence, the Vice-Chancellor himself paid a visit to the premises of the Company, and on his return to the Court, he said he had found that considerable vibration was perceptible in one or two of the rooms in the plaintiff's hotel. Still, it was a difficult matter to grant an injunction under such circumstances, and he was rather of opinion it was a case for damages. He subsequently assessed the damages at £100, and directed the Company to pay the costs of the action. At the same time he said he had never seen better working gear or machinery than were to be found at the premises of the Company. If the engines had been less well constructed, less well bedded, and less well worked, the annoyance and injury occasioned to the plaintiff would undoubtedly have been greater than was actually the case. Probably the Vice-Chancellor was partly influenced in this decision by the fact that the plaintiff is leaving the premises in about a year's time, and therefore the case could be well met as one of damages, instead of an injunction. Had an injunction been granted, a large number of persons who are now using the light would have been seriously inconvenienced. As a means of illuminating houses, offices, and other establishments, electric lighting is now making rapid progress, and would develope at a still more rapid rate only for the many obstacles now afforded by the regulations of City and Town Councils, Vestries, and other governing bodies.

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Local Museums.

I.

ONE of the first questions asked by the scientific visitor to a country town is: "Can you direct me to the Museum?" The answers often given are vague and unsatisfactory. The policeman has probably heard that there is "what they call a museum" in the little street leading out of the High Street, but as to what it contains, or who looks after its contents, he is profoundly ignorant. The majority of the inhabitants have never spent an hour inside its walls, and the visitor in some towns may wander for hours in his quest for this neglected institution, and when it is, at length, reached, the result to the itinerant student or wandering naturalist is in many cases decidedly disappointing. In one English country town a small building with a pretentious-looking signboard on which the word MUSEUM was inscribed in large letters, was once discovered, which on inspection was found to contain nothing more valuable than a dingy-looking tray of old coins, a diminutive stuffed specimen of an alligator, a few ivory ornaments labelled "from India," and a number of models in glass cases, which were to be set in motion by dropping a penny into an aperture provided for the purpose!

In the larger provincial towns, where special buildings have been erected at great cost, and in an increasingly large number of the smaller towns also, the local museum—thanks to the spread of scientific education—occupies a more honourable position than in the instance above described. There are many centres of industry and other districts scattered throughout the length and breadth of our country in which, either through the bequest of some local collector, or the energies of some educational institute, really valuable museums are to be found. Collections illustrating local species of birds or animals, special types or arrangements of objects of peculiar interest in the place where they are exhibited (and of the utmost value, also, to the general student who is unable to see these objects elsewhere), are frequently to be found amongst the many "curiosities" and miscellaneous properties of local country museums. At present there is no handbook or guide showing in what respect these local museums are especially valuable, or how far their contents have been kept scientifically up to date. Many workers in special branches of science would give much to know that in a certain museum in a given town they would find that which would be of the utmost assistance to them in prosecuting their original researches. It is too often the case that objects and collections of real value in a museum are, in a sense, hidden away almost unknown even to those dwelling in the immediate neighbourhood, and absolutely unknown to those who reside at a distance. Every museum where the spirit of progress and adabtability has sway, contains some feature of interest, and an attempt will be made to give in the series of papers on Local Museums in this journal some much needed details of the contents of the principal museums in our country, showing in what directions of study they are especially rich; how the various collections are arranged, and how their full educational value can best be utilised for the public benefit.

In Liverpool, archæology is brilliantly represented by the Mayer collection of antiquities, which will always remain a monument to the industry and research of its donor. The Derby collection of Birds, the Austen series of Crinoids, the celebrated Phillips collection of Minerals, and the collection of Coal Fossils arranged by the Rev. H. H. Higgins, illustrate diverse branches of natural science. The Manchester Museum at Owen's College has developed one of the best and most systematically arranged collections of Applied Geology out of London. The York Philosophical Society's Museum in the ancient grounds of St. Mary's Abbey is noted for its many palæontological rarities and for its complete series of Oolitic fossils. Leeds and other northern towns have now excellent museums. At Chester, the governing authorities of the Grosvenor Museum, by wisely concentrating their efforts on a purely local basis, are forming what will in a few years become a most valuable representative collection of the fauna and flora—living and fossil—of Cheshire, Shropshire, and North Wales. Of all of these, and many others, we hope to give descriptions which will not only be of use to the casual visitor, but also afford information which will be invaluable to everyone who is concerned with the intellectual welfare and progress of the country. And whilst dealing with the local museums of this country, the museums of the Continent will not be forgotten, for the value of such institutions for scientific purposes is more thoroughly recognised on the Continent than in our own country, and the museum is there made a valuable educational aid. Take for example that valuable collection of products illustrating the trade of the Dutch colonies, shown in one of the museums in Haarlem, or the many other industrial museums on the Continent, in America and elsewhere. These are of great value in general and technical education, and we in this country may do well to note fully their several useful features.

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TECHNICAL INSTRUCTION AT WARRINGTON.—At a general meeting of the Warrington Association for the Promotion of Technical Instruction held at the Museum, Mr. John Fairclough presiding, the following resolutions submitted by the council were considered and carried unanimously:—"That in the opinion of this association it is very desirable that the technical instruction bill, 1888, introduced by her Majesty's Government, should be amended in the following particulars:—First, that the definition of technical instruction should be so stated as to cover commercial subjects, including modern languages, bookkeeping, and shorthand; second, that in districts where there is no school board, the local authority should have power to provide manual as well as technical instruction for scholars attending elementary schools; to levy a rate for these purposes of one penny in the pound, in addition to the penny rate authorised by clause 3; to provide technical instruction for elementary scholars eligible to receive it under this act elsewhere than in the schools they attend, and in or out of school hours."

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Scientific Aspects of Health Resorts.

I.—Harrogate.

SITUATED in a pleasant and picturesque part of a county especially rich in features that can interest the geologist, botanist, entomologist, and other students of natural science, and within easy reach of many places of antiquarian and historical renown, Harrogate affords to those of its visitors who possess taste for science study many opportunities of adding to their knowledge and pleasures.

Its climate is remarkably bracing and invigorating, and the arrangement of the town—built as it is on high ground, but with a slope from an altitude of about 450 feet above sea level at High Harrogate, to about 300 feet at Low Harrogate, and from thence again a rise towards Harlow Hill—offers great choice in the selection of dwelling sites, from those well sheltered to others in more open positions; whilst a fine space of grass land, called the Stray, adds greatly to the circulation and purity of the atmosphere. The healthful character of the place is shown by its death rate, which has never exceeded 15.5 per thousand. It was as low in 1885 as 11.7, and the average of the seven years ending 1886 not more than 13.7 per thousand; whilst epidemic diseases are rare.

It is to the presence of many valuable medicinal springs that Harrogate, as is well known, owes its fame; and probably one of the first studies of a scientific visitor would be directed to the chemical and other characters of these waters, their sources and manner of collection, and the consideration of these would most certainly lead to the study of the geological features of the town and surrounding neighbourhood. The formation here belongs to the carboniferous system, and according to Mr. William Grainge, a local geologist who has devoted great attention to the subject, the town occupies the highest part of a round-backed ridge of land formed of alternate beds of millstone grit and shales, which beds, originally deposited under water in a position approaching the horizontal, have afterwards being upheaved, broken and thrown into confusion. The force of upheaval has elevated the central ridge, which extends from Forest Lane, on the road to Knaresborough, to Pannal Ash and Beckwith Head, the axis of elevation being a short distance south of the middle railway bridge on the Stray. By this upheaval the upper bed of millstone grit has been broken, and the sides severed by the interposition of a mass of shale and deeper beds of rocks until they are nearly two miles asunder.

Subsequent to the upheaval there has been deposition of clayey, shaley matter in horizontal beds, which at points again have been removed by water action. Other dislocations have also evidently taken place in the neighbourhood, one of the most noteworthy being that forming the valley on the north, which extends from Oakdale, near the gas works, to the Bogs. Many other examples of geological action might be mentioned if space allowed; but the following diagram, issued in 1882 in a circular of an excursion to the West Riding of Yorkshire by the Geologists' Association, and given as approximately correct as regards the surface, although to a certain extent hypothetical in respect to the folding of the Yoredale Rocks beneath the Stray, may be taken to indicate existing geological views respecting this neighbourhood.

Opportunities for noting the several features referred to above may be found in the railway cuttings and in numerous quarries, and one of these latter, that at the back of Cold Bath Road, is of especial interest, as here the stone, described on the Ordnance map as "Impure Limestone," is largely composed of fossilised animal remains, such as enter into the composition of mountain limestone, which this stone somewhat resembles. Other exposures are in local ties of much beauty, as for example at Birk Crag, where exists a charming wooded glen well worth visiting for its scenery alone.

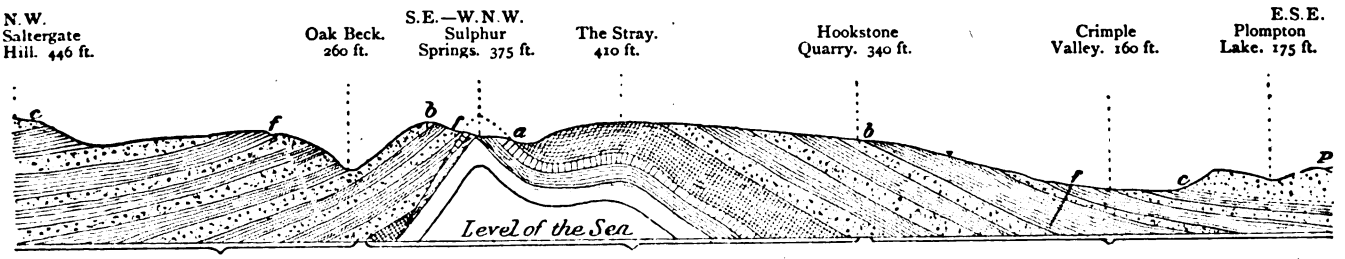
The special geological features have undoubtedly much to do with some of the curiosities of the medicinal springs, which are numerous, and are classified under the heads of strong sulphur water, through various gradations to mild sulphur, saline, saline chalybeate, Kissingen, chalybeate and chloride of iron, the latter having been first brought into notice by the late Dr. Sheridan Muspratt. It is impossible to discuss here the several peculiarities of each water, and endeavour to explain the causes of difference in character of springs situated so near each other, but as a matter of chemical geology the whole subject is one of extreme interest.

Mr. R. Hayton Davies, F.C.S., a well-known chemist residing at Harrogate, who has made numerous analyses of the several waters, estimates, in a paper on *The Mineral Wealth of Harrogate*, that the total yield of solid constituents from the several wells is not less than 100 tons per annum; and he well puts the problems that are of scientific interest in connection with these waters when he says:—"The spas may be regarded as a mine only partially explored. There is work enough for the geologist and chemist for many years to come, in such questions as—How do the waters acquire their sulphur constituents? and are they always present in the same combination? Is the formation of chloride of iron an original constituent, like sodium chloride, or produced by some process of decomposition? And other problems might be mentioned which await solution."

Whilst in the immediate neighbourhood of Harrogate there is so much to notice, there is still more to be studied by taking comparatively

DIAGRAMMATIC SECTION THROUGH THE HARROGATE ANTICLINAL.

(Saltergate Hill to Plompton Rocks, a little under six miles.)



Millstone Grit Series on the North Side of the Anticlinal.

Anticlinal of Yoredale Rocks.

Millstone Grit Series on the South Side of the Anticlinal.

Explanation.—a. Harrogate roadstone. On the north side of the anticline this is forced against the principal fault *(f) b.* The Uppermost Kinder Grit. Quarried on the south side of the anticlinal at Hookstone; on the north side of the anticlinal forms Birk Crag. *c.* Approximate position of the fossiliferous band (Cayton Gill Beds) in the Millstone Grit on either side of the anticlinal. *P.* Permian Beds (here Magnesian Limestone) resting uncomformably on the Plompton Grits.

THE YOREDALE ROCKS are here composed of—*Lower Grits, Lower Shale, Calciferous encrinital Grit* (Harrogate roadstone, *a*), *Upper Shale.* MILLSTONE GRIT.—The three lowest Grit Beds with their accompanying Shales are called the *Fourth*, or *Kinder Grits.* A thick Shale intervenes. The upper series of Grits and Shales are referred to the *Third Grits.*

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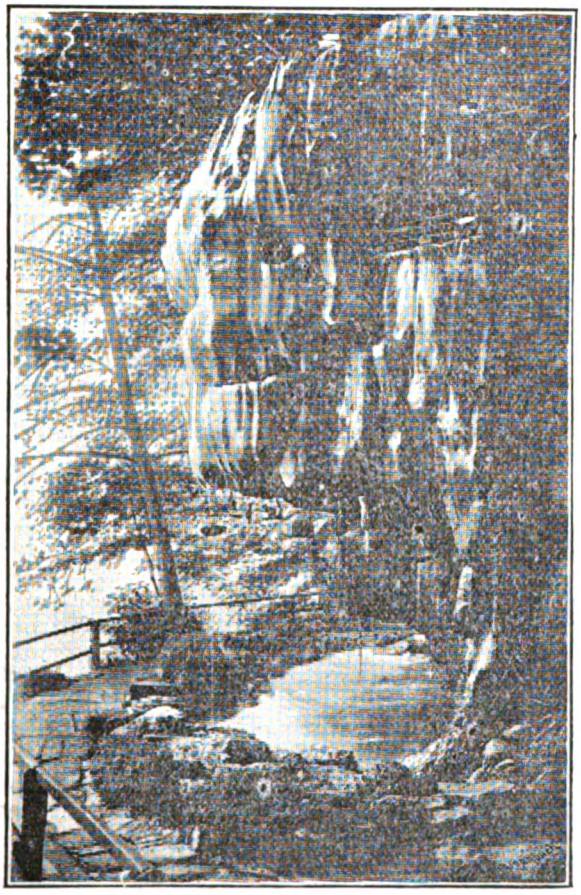
short excursions, and a few localities may now be referred to by way of examp'e. At Knaresborough, about three miles away, and at Grimbald Crag and Plompton Rocks, may be noted many interesting geological features. The Dropping Well at Knaresborough, of which we give an illustration, is worth attention. Reached by a pleasant pathway on the banks of the River Nidd—to which entrance is gained by a small payment at the "Mother Shipton" Hotel—is a small spring of water, issuing from the magnesian limestone, which, flowing over a mass of rock, deposits a considerable amount of earthy salts on its surface, adding much to its substance; but from time to time the added matter is removed, lest the increased weight might cause the rock to



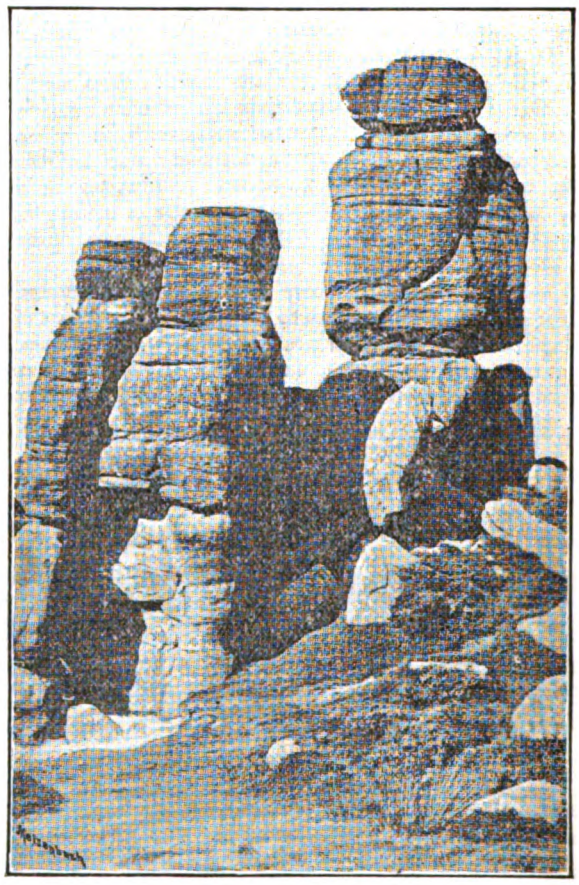
The Dropping Well, Knaresborough.

over-balance. Many articles, such as gloves, hats, boots, dolls, dead animals, and plants are so hung on or from the rock that the water can drop on to them, and in the course of a few months become quite covered with the earthy matters, and are thus "*petrified*." The action is very similar to that noticeable at Matlock, in Derbyshire.

An analysis lately made in the writer's laboratory shows the water to contain 197 grains per gallon of solid constituents, chiefly lime salts, and the deposit gave the following percentage results:—Carbonate of lime, 94·28; carbonate of magnesia, 0·75; sulphate of lime, 4·37; oxide of iron, silica and alumina, 0·60.

Another place well worth visiting is Pateley Bridge, situated in a neighbourhood of much diversified scenery. Here there is a stalactite cavern that will repay close examination, and the lovely Ravensgill Glen, where may be studied amidst a scene of great beauty the action of water in scooping out a valley, and the several phenomena attaching to such action. The walk through the glen and on to Guy's Cliff is charming, and many are the interesting facts regarding water work that may be seen here. There are also other places close by that may be visited with pleasure and profit.

A drive from Pateley Bridge of about three quarters of an hour, and a stiff walk through some fields and up the side of a hill, will take the visitor to the famous Brimham Rocks. These rocks may also be reached by driving from Harrogate, and conveyances go there regularly; and, although the road is a somewhat awkward one, the drive is very enjoyable. We give two illustrations of these rocks, which consist of the lower bed of the red sandstone of Plompton and Knaresborough, and form a cliff about half a mile in length, from which the ground



Brimham Rocks.

slopes rapidly to the valley below. These rocks present very many curious and fantastic forms, due probably, first, to the action of sea waves beating upon them in some remote period, and subsequently to ordinary atmospheric agencies, both causing the removal of the softer parts and leaving the harder less acted on.

The several examples already alluded to by no means exhaust the opportunities for geological study, but we can now only refer an intending student to such works as Bird's "Geology of Yorkshire;"* "The Geology of Harrogate," by Mr. William Grainge;† and "West Yorkshire," by J. W. Davies and F. Arnold Lees.‡ This latter work is not only an excellent guide to the geological student, but gives much information respecting the botany of

* Published by Simpkin, Marshall & Co., London, and Thomas Brear, Bradford.

† Published by L. Reeve & Co., Henrietta Street, London.

‡ Published by R. Ackrill, *Herald* Office, Harrogate.

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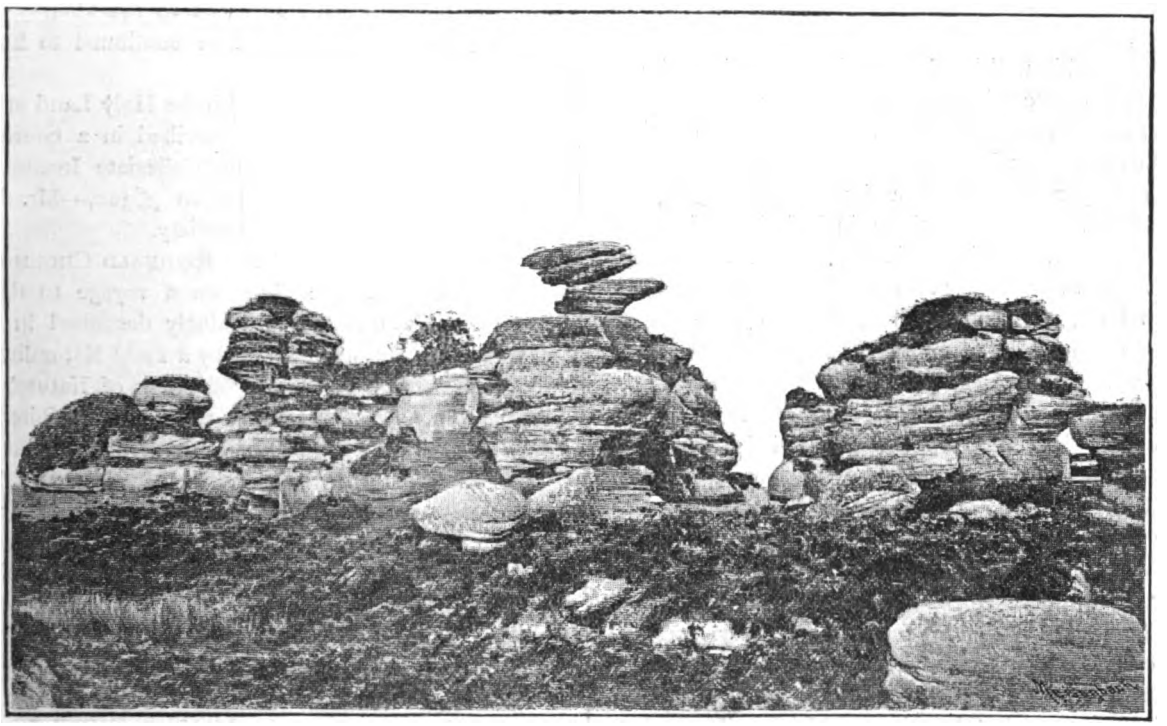
the district; and at the places already mentioned, and numerous others round Harrogate, and easily reached by short excursions, the botanist will find a flora not only extensive, but of very great interest; and, as already hinted at, other scientific students will not be at a loss for the special objects of their inquiries. As a botanical guide probably there is no better than "The Flora of West Yorkshire," by Frederic Arnold Lees, lately published by Lovell, Reeve & Co., and forming the second volume of the Botanical Series of the Transactions of the Yorkshire Naturalists' Union.

In this short and necessarily imperfect sketch it has been impossible to mention all the many places of scientific interest in the neighbourhood, but the museums at Leeds and York must not be omitted. We hope soon to refer to them more at length, as they contain valuable collections. And then, again, a scientific visitor to Harrogate would do well to note the doings of the many societies existing in Yorkshire, for that county seems to be one in which the scientific spirit is ever kept alive, and good, steady, valuable work accomplished.

A. Norman Tate.



Brimham Rocks.

A New Photographic Survey.

THE Birkenhead Amateur Photographic Society have recently inaugurated a novel method of surveying that part of the county of Chester which lies within their range. An ordinary survey simply records the topographical features of a locality; it makes no atttempt to preserve them in any pictorial fashion. In course of time, many old sites of historical interest entirely disappear, or they are "improved" off the face of the earth. Travellers who carefully consult their ordnance maps will frequently come across the symbol of an ancient battle-field, site of an old castle or prehistoric relic, and, too often, only the "site" remains, with few, if any, traces by which it can be locally identified.

Struck with the fact that there exists in that part of Cheshire which includes the little peninsula of Wirral, a large number of ancient buildings and localities interesting to the historian, the antiquarian and lover of the picturesque, the semblance of which it would be desirable to perpetuate by means of the camera, the energetic members of the Birkenhead Society have entered upon a new departure in photographic work. A map of Wirral has been specially prepared and divided into sections alloted to different members. Each member is placed in possession of that portion of the map illustrating his selected section, together with a summary of the chief antiquarian and topographical features of interest in the neighbourhood, ably compiled by Mr. John Hargreaves (Mem. Hist. Soc. Lanc. and Cheshire). Armed with this information, each member sets about photographing whatever is worthy of pictorial preservation, and, at the end of the summer's work, will, in all probability, have the satisfaction of seeing his art handiwork displayed with the similar productions of his photographic brethren in a local exhibition. Whilst the number of amateur photographic societies is so largely increasing, it is satisfactory to find some of them undertaking really useful work of this kind, instead of wasting their energies over the usual miscellaneous assortment of subjects without any definite purpose in view.

We may also remark that Wirral is by no means the only locality where a photographic survey would be useful. There are many districts of historic interest far surpassing that of Cheshire; indeed, there is no county in England where some points of beauty or valued recollection could not be found fitting subjects for the art of the photographer. The necessity, however, of *systematic* application to such a work is paramount. Nor should the scientific aspect be overlooked. Landscape features of a peculiar character, geological sections, examples of special forms of vegetation, are all worthy of note, and a collection of photographs, illustrating in a complete manner the natural history of a given part of the county, would be of lasting value as an aid to scientific research.

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Our Portrait Gallery.

I.—Rev. HENRY H. HIGGINS, M.A.

In a scientific journal published in Liverpool no one can more appropriately appear first in our Gallery of Representative Men of Science than the Rev. Henry Hugh Higgins, M.A. The long and important services which Mr. Higgins has rendered to the cause of education in this district, his untiring labours in connection with the development of the Liverpool Free Public Museum, and his incessant endeavours to bring the grand truths of science within the comprehension of the million, are as well known as they are appreciated over a far wider area than the neighbourhood with which the principal life-work of Mr. Higgins has been more immediately associated. Few men have devoted themselves more assiduously to the higher educational needs of modern life, or who have so well succeeded in impressing upon those responsible for popular instruction the advantages which must accrue from an extended knowledge of natural science. In the furtherance of this object, Mr. Higgins has not relied solely upon precept, although the numerous publications which have emanated from his pen have had a decided influence in this direction. His labours have been always of the thoroughly practical order, and much has been achieved by the force of his energetic example. From a very early age Mr. Higgins attached himself to the study of Natural History, and it is in that extended department of knowledge now grouped under the head of Biology that his matured labours have been mainly concerned. The science of Biology has perhaps the widest range of any of the purely natural sciences. Not only is the entire existing field of animate creation, both animal and vegetable, brought within its scope; the far-reaching extent of the geological record, as revealed in the solid crust of the globe, is also open to its investigations. A science, then, which does not limit its range to the present epoch, but connects, link by link, existing forms of life with the early types of a remote antiquity, offers problems of the highest interest, and to the solution of these Mr. Higgins has contributed many observations of value to the student. In these researches Mr. Higgins has persistently endeavoured to proceed "from the known to the unknown," undismayed by utterances of dogmatic teachers, however high an authority they might profess to have attained.

The following brief biographical details will doubtless be of interest to readers of this journal:—

Born at Turvey Abbey, Beds., on January 28th, 1815, Mr. Higgins received his elementary lessons from the village schoolmaster. In 1833 he entered Corpus Christi College, Cambridge, and won his B.A. degree in 1836. He was admitted to priest's orders in 1839, and spent four years of ministerial duty in the town of Wolverhampton, proceeding in the following year to Shrewsbury. Mr. Higgins came to reside in Liverpool in 1842, and occupied himself with more congenial educational work, being Inspector of the Schools of the Church of England School Society, a position which he resigned in 1848, though, as Hon. Secretary, and afterwards Hon. Treasurer, he retained connection with the Society. After performing other ministerial duties he was appointed Chaplain to the County Asylum, Rainhill, in 1853, which post he continued to hold until 1886.

A long Eastern tour through the Holy Land and Egypt was undertaken in 1848, and described in a course of six lectures given at the Liverpool Collegiate Institution, the proceeds of which—amounting to £300,—Mr. Higgins generously gave to the School Society.

In 1876 he accompanied Mr. Reginald Cholmondeley in his steam yacht (the *Argo*) on a voyage to the West, which Mr. Higgins has charmingly described in a small 12mo. volume entitled "Notes by a Field Naturalist in the Western Tropics." Valuable collections of Natural History specimens now interspersed in the series exhibited in the Liverpool Free Public Museum resulted from the voyage. This Museum is largely indebted to Mr. Higgins' labours. For a long series of years he has acted as Chairman of the Museum Sub-committee of Management, and he has, besides, devoted many hours weekly to the classification and arrangement of the collections in the possession of the city. In connection with this Institution Mr. Higgins is the author of three useful handbooks, viz., a "Synopsis of the Invertebrata," a "Museum Memorandum Book," and a popular pamphlet entitled "Museum Talk," of which more than twenty-five thousand copies have been sold at a nominal price in the Museum buildings. He has also published an Essay on "Museums of Natural History" (contributed originally to the Literary and Philosophical Society of Liverpool), which is replete with practical suggestions on museum management and appliances. "The most important function of a museum," states our author in this work, "is not so much to instruct, as to win and encourage minds to get themselves instructed through habits of observation." One of the most valuable collections in the Museum is a fine series of Coal Measure fossils, collected by Mr. Higgins himself from a railway cutting at Ravenhead, near St. Helens. In 1880 he was fortunate in securing for the museum a numerous series of *Cirripedes*, collected in the "Beagle" by Charles Darwin. These were duplicates remaining after Mr. Darwin had (as he states in a letter to Mr. Higgins), made the British Museum collection as perfect as he could. The system of circulating boxes of museum specimens for use in schools was also originated by him. On more than one occasion Mr. Higgins has received from admirers of his work,

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THE REV. HENRY H. HIGGINS, M.A.

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testimonials, showing how greatly his labours have been appreciated.

Mr. HIGGINS founded, in the year 1860, the Liverpool Naturalists' Field Club, of which he is still President; and he has also occupied the presidential chairs of the Literary and Philosophical and Microscopical Societies of Liverpool. His contributions to the published "Transactions" of these societies, besides those of other similar associations, have been exceedingly numerous. They will be found conveniently collected in three 8vo volumes, under the title of "*Opuscula*," in the Free Public Library of Liverpool. The papers contained in these volumes range in date from 1855 to 1887, and deal with a variety of scientific subjects in a light and pleasing, yet instructive manner. In all his writings, Mr. HIGGINS is a true exponent of the "poetry of science," which is far too often neglected in our modern haste for the rapid acquirement of knowledge—so characteristic a feature of the age in which we live.—O. W. J.

River Deposits in the Ribble Valley.

BY W. HEWITT, B.SC.

FOR some time past, very extensive engineering operations have been in progress in connection with the estuary of the river Ribble, at Preston, in Lancashire. These have been undertaken with the view of improving the navigable channel and providing dock accommodation, in the hope that some share of the commerce, which now finds its way to the Mersey, may thus be attracted to the more northern seaport. There seems to be undoubted evidence that, in the time of the Romans, the estuary of the Ribble was far more important than that of the Mersey. The latter, in fact, would seem to have been so insignificant as not to be considered worthy of mention by those authors who do not fail to record the estuaries of the Dee and the Ribble. This fact has greatly exercised the minds of geologists and historians of the district; and several theories have been propounded in explanation. It would certainly appear that great changes have taken place in this part of the coast, and that these changes have led to the gradual silting up of the estuaries of the Ribble and the Dee, while that of the Mersey has become the seat of a commerce, second to none in its extent and importance.

The extensive operations in the Ribble, to which reference has been made, have met with considerable opposition on the part of a number of the inhabitants of Preston, who have great doubts as to whether the town will ever recoup itself for the vast outlay of money which is required for the prosecution of such an undertaking. Under an Act of Parliament obtained in 1883, authorising these works, a sum of over £660,000 was borrowed, and the Corporation of Preston are now promoting a bill which will give them power to borrow half-a-million more, in order to complete the work.

With the financial aspect of the scheme we have now, however, nothing to do; but, during the progress of the work an excellent opportunity has been afforded for studying the nature of the deposits laid down by the river in this part of its course—and fortunately, advantage has been taken of this opportunity and some valuable information obtained and placed on record. In the Proceedings of the Liverpool Geological Society for 1886-7, a paper by Mr. E. Dickson is published, entitled "Notes on the Excavations for the Preston Docks," and the same gentleman read another paper before the same society, on February 14th, 1888, giving further information as to the results obtained since the date of his previous communication. From the published paper referred to, we learn that the scheme of operations just below Preston, involves—(1) cutting a new river channel 3000 yards long and 300 feet wide, (2) making a dock 3000 feet long and 600 feet wide, and (3) filling up a portion of the present channel, and utilising another portion as a timber dock.

The whole of the excavations are in the old deposits laid down by the river itself. These consist of beds of silt, sand, and gravel, with occasional thin beds of peat. The gravel is well water-worn and consists, for the most part, of stones derived from the beds of glacial drift, out of which the river has cut its channel. The great horizontal extent of the deposits is due to the fact that the river has wandered from side to side of its valley, filling up its old course with debris, as it cut out for itself a new one. It appears, from an old map dated 1806, that the river at that time flowed in the very course now being artificially excavated for it, and, that since that period, it has made its way to almost the opposite side of the valley.

The vast amount of matter brought down by the river and accumulated at this part of its course, and the constant migration of the channel from one part of the valley to another, are facts of the greatest importance in connection with the history of the river. Not only did it bring down this inorganic material, but now and then trees of considerable size were floated down and embedded in the gravel. These consist for the most part of beech and oak. Embedded in the lower deposits of sand and gravel, have also been found numerous animal remains. As might be expected in estuarine deposits of this character, there is a curious commingling of terrestrial and marine forms. Thus, along with remains of the whale, we have numerous antlers and other portions of the red deer, a number of heads, horns, &c. of the wild ox (urus), and remains of the horse, sheep, goat, &c.

But, probably, the greatest interest is to be found in connection with the remains and works of man which have been discovered in these beds. A number of human skulls

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have been found, apparently somewhat varied in type; a beautifully-formed bronze spear head, in a fine state of preservation, and an iron axe. More recently—in October of last year—a canoe was found, some fourteen feet below the surface of the gravel. This canoe is remarkably short, being only 8 feet 9 inches in length, and is formed from a single log of oak. All these interesting objects have been placed in the Preston Museum.

It is not often that the opportunity is afforded, on such a large scale, of studying the nature and arrangement of the materials accumulated in the lower portion of a river channel. And, as in the present case, the interest in such deposits is not confined to the geologists; for buried in these materials may be objects interesting in the highest degree to the antiquarian, the ethnologist, and other workers. It is well, therefore, that local observers should give careful attention to engineering operations of this character, and carefully note and record the points of interest as they arise, as has been done in the case of the works in the Ribble Valley, at Preston.

Technical Education.

It is proposed to examine and review from time to time in the columns of *Research* matters connected with Technical Education, and it will be well, therefore, to commence with a brief account of what has already been done in the country in this direction. In the first place, it must be remembered that the most important institutions for Technical Education are the workshops and factories of this country; and it is to these that we owe our position as having produced, and probably still producing, the greatest number of successful inventions and practical men of any nation, notwithstanding all alarmist utterances to the contrary. Such training will not be directly considered in discussing Technical Education, but only such instruction as may be said to form the object of the work of an institution, and not merely occuring as incidental in the production of manufactures or machinery.

In 1835, shortly after the first grant towards elementary education had been made by Parliament, there was appointed a Committee to inquire into the best means of extending a knowledge of design among the people, specially the manufacturing population of the country, and also to inquire into the constitution, management, and effects of institutions connected with the arts. In 1849 another Committee of the House of Commons was appointed to inquire into the working of schools established as a result of the former Committee, the work of such schools not being regarded as altogether satisfactory, from the fact that the teaching was said not to be of a sufficiently practical character. The questions thus raised were still further opened out by the great Exhibition of 1851, from which the Science and Art Department of the Council of Education may be said to have sprung. The work of the Science and Art Department was really inaugurated in 1857, and practically has a five-fold object. First, the conducting of public examinations in all parts of the country; second, making payments to teachers for giving instructions in subjects recognised by it; thirdly, offering scholarships and exhibitions to be competed for at the examinations; fourthly, making grants towards the erection of suitable buildings; and fifthly, giving aid towards the purchase of scientific apparatus. In the year 1861 there were but 1,000 students examined in science, while last year the number of examination papers worked was nearly 132,000.

The following table shows that the progress which has been made during the last ten years is steady and continuous :—

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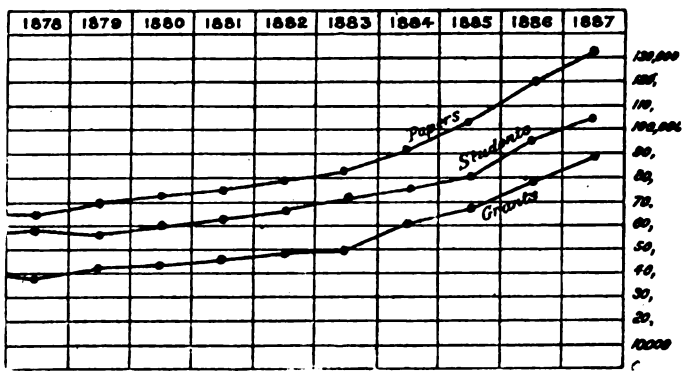
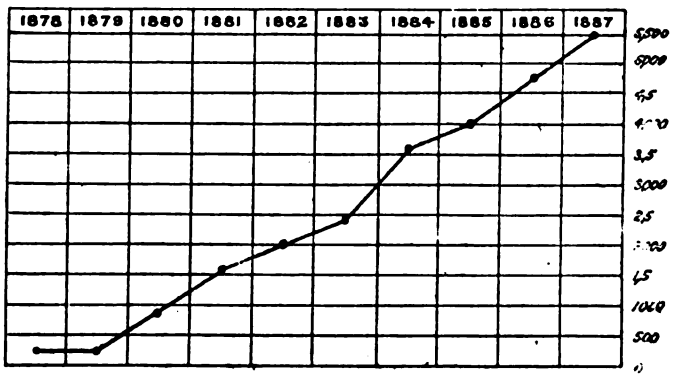


Besides the Science and Art Department, the City and Guild of London have, since 1878, carried on the work previously commenced by the Society of Arts in 1873, and the following figures show the progress of the work, which is also better realised by the graphic representation in the next figure :—

SOCIETY OF ARTS AND CITY AND GUILDS EXAMINATIONS.

Years.	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887
No. of Candidates.	184	202	803	1563	1972	2397	3635	3968	4764	5508



In addition to the work of these institutions there are science lectures and classes held throughout the country in connection with the University extension scheme, and the evening classes of the various

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University Colleges and Technical Schools now established in most of our large cities. The work of higher Technical Education is also carried on in the Universities, in various University Colleges, and in the central institutions at London.

Thus, it will be seen, that a most important work has been going on for many years in this country, and one which is in many respects without a parallel, but this work, except for higher Technical Education, is to a great extent limited to evening class instruction, and many of the most enlightened public men have for some time urged the more thorough recognition of the teaching of science and provision for manual training in the elementary schools throughout the kingdom. In these matters this country does not appear to be on a level with some of the continental nations. The necessity for some active movement to remedy a serious defect has been recognised by the introduction of a bill by the Government for the promotion of technical instruction. This bill, which failed to become law last year, has been introduced this year, with certain important modifications, and the following is a brief outline of its scope. In the first place, School Boards would be empowered to supply, or aid in supplying, manual and technical instruction in public elementary schools, whether under their own management or not. Instruction, however, would be confined to scholars attending at an elementary school (including evening classes recognised by the Education Department). There is no restriction as to manual instruction, which may be given to children of any age, but technical instruction, that is, instruction in Science and Drawing, would be confined to those passing examination nearly equivalent to the sixth standard. The rate which might be raised for this purpose would not be allowed to exceed 1d. in the £. In addition to these, local authorities empowered to carry out the Public Libraries Act, may also assist in the advancement of higher technical instruction, they also having the power to spend not more than 1d. in the £ for this particular purpose. There is not space to criticise at length this important bill, but it is highly satisfactory to know that we have a powerful National Association for the Promotion of Technical Education, which is collecting information and opinions upon each detail of the bill throughout the country, and organising a Conference on the subject. But more than this, we have in this city, what has been entitled the Liverpool Association for the Promotion of Technical Education, which has been established under the most auspicious circumstances in being, probably, one of the most, if not actually the most, representative body in the whole city. The Council of this Association numbers 25 members, consisting of the following bodies:—Liverpool Council of Education, University College, Liverpool School of Science, Liverpool Science and Art Classes, Liverpool Science and Art Teachers' Association, Liverpool Training School of Cookery, Parish of Liverpool Industrial School, Gordon Working Lads' Institute, Liverpool Teachers' Guild, Liverpool College School, Liverpool Institute School, Royal Institution School, St. Francis Xavier's School, Diocesan Board of Education, Liverpool School Board, Elementary School Managers, Library and Museum Committee, Liverpool and District Teachers' Association, Liverpool Branch Society of Chemical Industry, Liverpool Trades Council, Liverpool Engineering Society. In addition to the twenty-five ordinary members of Council, its Vice-Presidents consist of the Mayor of Liverpool; the Chairman of the School of Science and of Science and Art Classes; the Principal of University College; Mr. Samuel Smith; and Mr. Fitzpatrick. Among other names on the Council are those of Miss F. Calder, Miss Grayson, Sir James Picton, Messrs. R. R. and O. H. Rathbone, Mr. Norman Tate, Mr. Frederick Edwards, Canon McNeile, Rev. T. Murphy, Mr. T. C. Ryley, Mr. Edward Davies, Mr. James Birchall, Mr. W. Oulton, Mr. W. Crosfield, Mr. R. C. Lindsay, Rev. F. Dyson, Mr. Douglas Hebson, Mr. E. Taylor, Dr. Campbell Brown, Mr. Geo. Parkin, Mr. Watkin, and Mr. Brindle. The Chairman is Sir James Poole, who during his year of mayoralty took such a warm interest in the elementary schools of the city. Its Treasurer is Mr. Fenwick Harrison; Honorary Secretaries, Mr. Reginald Bushell, and Professor Hele Shaw. In future articles the work of this Association will be from time to time given, but its officers and Council are now actively engaged in securing proper representation of the particular views to be taken in the interests of the city in connection with the Government bill. It is satisfactory to know that the constitution of the association is such that membership will be invited so as to embrace every section of the community, and any individual will be entitled to become associate and have equal power of voting with other members by payment of the modest annual subscription of 2s. 6d. A preliminary report of the Association has been issued, but it is not proposed to make a general appeal for membership until the fate of the Government Bill is known, and the actual programme of work for the coming winter has been prepared. The latter subject, which is receiving careful consideration by the officers of the Association, will form a matter of no little interest to the general public, who have long been waiting to see some practical outcome of all the talk which has been devoted to the subject of this article.

H. S. Hele Shaw.

A Phenomenon.

With the march of time, the multiplied discoveries of science, and the increase of knowledge, many of the things which to our forefathers appeared as wonderful, startling, and even miraculous, are now taken as ordinary facts of nature, and in many no longer excite fear or dread alarm. The sudden appearance of the moulds; the rapid spread of green or red patches in and upon unlikely places—for example, the capping of snow with a coat of bright red or green; the spreading of a carpet of olive, blue, or blue-green over the surface of a clayey soil in the brief space of one night; or the advent of blood-red water and its almost instantaneous disappearance. These and a hundred other so-called phenomena are known and understood to the students of Biology, and might, with a little thoroughly interesting study, be known to every intelligent person. Yet, alas! too many remain in the most thorough ignorance of the most ordinary, and at the same time some of the mightiest, of Nature's workings. Professor Tyndall once said, "Facts looked at directly are vital; but when put into words half the sap is taken out of them." The truth of this we keenly feel when we are about to invoke the minute things of Nature to unfold the story of her doings. We venture, however, to ask our readers to note, not at first by the aid of that super-added optical appliance by which a thousand or two thousand diameters of magnification are added to our vision, but with the eye of the ordinary student of Nature, walking the shady lanes and perambulating the ponds and ditches of our neighbourhood.

We are a few minutes' walk from Huyton Station, and have turned aside from the dusty road into a quiet lane, by the side of which we notice four or five ponds, cosily nestling beneath overhanging trees, surrounded by grassy, sloping banks. The water is not abundant, and the connection between two or three of these ponds, which is usually by an arm of water, is now maintained by the slightly-raised muddy bottom. We approach the side of the first pond, and the eye is gratified by the sight of the spreading corollas of the water buttercups (*Ranunculus aquatilis*), as they daintily sit on the surface of the water; the large spreading oval leaves of the pond-weed are also a welcome sight, carrying beneath the green or brown upper surface streaks of transparent jelly, containing the spawn of our old friend *Stagnalis*, the water snail. Yes, there are many specimens of this gasterpod, with its curious custom of carrying its house upside down, and using its foot

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have been found, apparently somewhat varied in type; a beautifully-formed bronze spear head, in a fine state of preservation, and an iron axe. More recently—in October of last year—a canoe was found, some fourteen feet below the surface of the gravel. This canoe is remarkably short, being only 8 feet 9 inches in length, and is formed from a single log of oak. All these interesting objects have been placed in the Preston Museum.

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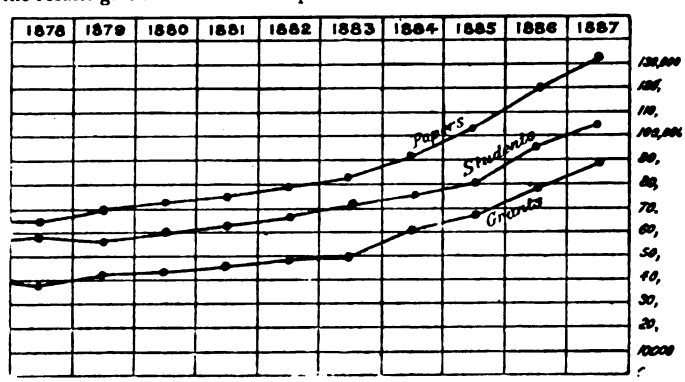
1887	£88,000	103,362	131,896

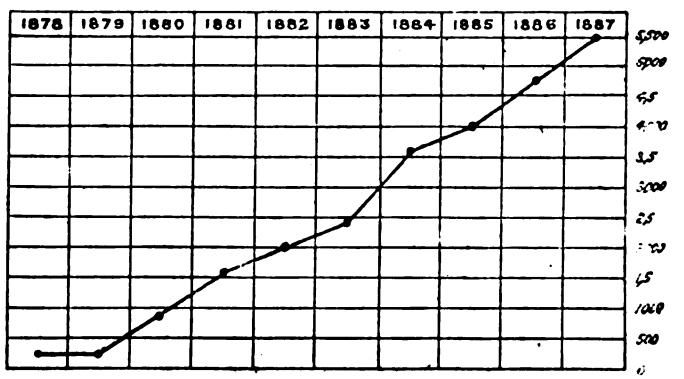
This fact being more strikingly brought out by the following, in which the results given in the table are plotted :—



Besides the Science and Art Department, the City and Guild of London have, since 1878, carried on the work previously commenced by the Society of Arts in 1873, and the following figures show the progress of the work, which is also better realised by the graphic representation in the next figure :—

SOCIETY OF ARTS AND CITY AND GUILDS EXAMINATIONS.

Years.	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887
No. of Candidates.	184	202	803	1563	1972	2397	3635	3968	4764	5508



In addition to the work of these institutions there are science lectures and classes held throughout the country in connection with the University extension scheme, and the evening classes of the various

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University Colleges and Technical Schools now established in most of our large cities. The work of higher Technical Education is also carried on in the Universities, in various University Colleges, and in the central institutions at London.

Thus, it will be seen, that a most important work has been going on for many years in this country, and one which is in many respects without a parallel, but this work, except for higher Technical Education, is to a great extent limited to evening class instruction, and many of the most enlightened public men have for some time urged the more thorough recognition of the teaching of science and provision for manual training in the elementary schools throughout the kingdom. In these matters this country does not appear to be on a level with some of the continental nations. The necessity for some active movement to remedy a serious defect has been recognised by the introduction of a bill by the Government for the promotion of technical instruction. This bill, which failed to become law last year, has been introduced this year, with certain important modifications, and the following is a brief outline of its scope. In the first place, School Boards would be empowered to supply, or aid in supplying, manual and technical instruction in public elementary schools, whether under their own management or not. Instruction, however, would be confined to scholars attending at an elementary school (including evening classes recognised by the Education Department). There is no restriction as to manual instruction, which may be given to children of any age, but technical instruction, that is, instruction in Science and Drawing, would be confined to those passing examination nearly equivalent to the sixth standard. The rate which might be raised for this purpose would not be allowed to exceed 1d. in the £. In addition to these, local authorities empowered to carry out the Public Libraries Act, may also assist in the advancement of higher technical instruction, they also having the power to spend not more than 1d. in the £ for this particular purpose. There is not space to criticise at length this important bill, but it is highly satisfactory to know that we have a powerful National Association for the Promotion of Technical Education, which is collecting information and opinions upon each detail of the bill throughout the country, and organising a Conference on the subject. But more than this, we have in this city, what has been entitled the Liverpool Association for the Promotion of Technical Education, which has been established under the most auspicious circumstances in being, probably, one of the most, if not actually the most, representative body in the whole city. The Council of this Association numbers 25 members, consisting of the following bodies:—Liverpool Council of Education, University College, Liverpool School of Science, Liverpool Science and Art Classes, Liverpool Science and Art Teachers' Association, Liverpool Training School of Cookery, Parish of Liverpool Industrial School, Gordon Working Lads' Institute, Liverpool Teachers' Guild, Liverpool College School, Liverpool Institute School, Royal Institution School, St. Francis Xavier's School. Diocesan Board of Education, Liverpool School Board, Elementary School Managers, Library and Museum Committee, Liverpool and District Teachers' Association, Liverpool Branch Society of Chemical Industry, Liverpool Trades Council, Liverpool Engineering Society. In addition to the twenty-five ordinary members of Council, its Vice-Presidents consist of the Mayor of Liverpool; the Chairman of the School of Science and of Science and Art Classes; the Principal of University College; Mr. Samuel Smith; and Mr. Fitzpatrick. Among other names on the Council are those of Miss F. Calder, Miss Grayson, Sir James Picton, Messrs. R. R. and O. H. Rathbone, Mr. Norman Tate, Mr. Frederick Edwards, Canon McNeile, Rev. T. Murphy, Mr. T. C. Ryley, Mr. Edward Davies, Mr. James Birchall, Mr. W. Oulton, Mr. W. Crosfield, Mr. R. C. Lindsay, Rev. F. Dyson, Mr. Douglas Hebson, Mr. E. Taylor, Dr. Campbell Brown, Mr. Geo. Parkin, Mr. Watkin, and Mr. Brindle. The Chairman is Sir James Poole, who during his year of mayoralty took such a warm interest in the elementary schools of the city. Its Treasurer is Mr. Fenwick Harrison; Honorary Secretaries, Mr. Reginald Bushell, and Professor Hele Shaw. In future articles the work of this Association will be from time to time given, but its officers and Council are now actively engaged in securing proper representation of the particular views to be taken in the interests of the city in connection with the Government bill. It is satisfactory to know that the constitution of the association is such that membership will be invited so as to embrace every section of the community, and any individual will be entitled to become associate and have equal power of voting with other members by payment of the modest annual subscription of 2s. 6d. A preliminary report of the Association has been issued, but it is not proposed to make a general appeal for membership until the fate of the Government Bill is known, and the actual programme of work for the coming winter has been prepared. The latter subject, which is receiving careful consideration by the officers of the Association, will form a matter of no little interest to the general public, who have long been waiting to see some practical outcome of all the talk which has been devoted to the subject of this article.

H. S. Hele Shaw.

A Phenomenon.

With the march of time, the multiplied discoveries of science, and the increase of knowledge, many of the things which to our forefathers appeared as wonderful, startling, and even miraculous, are now taken as ordinary facts of nature, and in many no longer excite fear or dread alarm. The sudden appearance of the moulds; the rapid spread of green or red patches in and upon unlikely places—for example, the capping of snow with a coat of bright red or green; the spreading of a carpet of olive, blue, or blue-green over the surface of a clayey soil in the brief space of one night; or the advent of blood-red water and its almost instantaneous disappearance. These and a hundred other so-called phenomena are known and understood to the students of Biology, and might, with a little thoroughly interesting study, be known to every intelligent person. Yet, alas! too many remain in the most thorough ignorance of the most ordinary, and at the same time some of the mightiest, of Nature's workings. Professor Tyndall once said, "Facts looked at directly are vital; but when put into words half the sap is taken out of them." The truth of this we keenly feel when we are about to invoke the minute things of Nature to unfold the story of her doings. We venture, however, to ask our readers to note, not at first by the aid of that super-added optical appliance by which a thousand or two thousand diameters of magnification are added to our vision, but with the eye of the ordinary student of Nature, walking the shady lanes and perambulating the ponds and ditches of our neighbourhood.

We are a few minutes' walk from Huyton Station, and have turned aside from the dusty road into a quiet lane, by the side of which we notice four or five ponds, cosily nestling beneath overhanging trees, surrounded by grassy, sloping banks. The water is not abundant, and the connection between two or three of these ponds, which is usually by an arm of water, is now maintained by the slightly-raised muddy bottom. We approach the side of the first pond, and the eye is gratified by the sight of the spreading corollas of the water buttercups (*Ranunculus aquatilis*), as they daintily sit on the surface of the water; the large spreading oval leaves of the pond-weed are also a welcome sight, carrying beneath the green or brown upper surface streaks of transparent jelly, containing the spawn of our old friend *Stagnalis*, the water snail. Yes, there are many specimens of this gasterpod, with its curious custom of carrying its house upside down, and using its foot

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as a float, moving slowly along the surface, quietly, except for its occasional well-known bubbling of water, caused by the letting out of air, which has served the creature for respiration. While we are eyeing these more obvious objects we see what appears to be brown or black-brown dust, here and there, everywhere over the surface of the pond, at the sides, too, where the tiniest of ripples, caused by the gentlest breeze that fans the surface, strikes, carrying an outline of this dust; the stems, leaves, and flowers of the pond are all covered. As we dip a small bottle into the water, the fingers and back of the hand become dotted with black specks, and here and there smeared as if with soot. We look up and aronnd to see the character of the trees and foliage; surely it must be one of those showers from the coniferæ or willows, which commonly shed their pollen early in the season: it cannot be, for the colour answers not to pollen; there must be close by a prolific growth of ferns, and by the aid of the wind a shower of spores has fallen: but all too early for such a phenomenon. Our next thought is that some country sweep has been discharging the contents of his bag near the pond, for the appearance is very much like that of soot scattered over the water. But in vain are these thoughts, Nature has a thousand ways of deceiving the superficial observer.

We now secure a dip of the water with some of the dust, and by the aid of a pocket lens behold a teeming mass of moving, living organisms: black they are, but some few have a less sombre hue than others. They madly rush hither and thither, and wildly gyrate, and were it not for the number we despair of having the remotest chance of gathering the outline of one, but being hurried and jostled in their narrow prison, like passengers on a limited footwalk, some apparently are obliged to hold to the sides of the glass; cone shape, trumpet shape, or a blending of the two. We are satisfied we know our prisoners: they belong to an interesting and ancient family of the cognomen of *Stentor*. They were first observed occupying a similar habitat nearly one hundred and fifty years ago, and, like their numerous relatives, superior and inferior, were carefully considered and described, and their earliest bit of history forms the subject of a paper in the "Philosophical Transactions" for the year 1744, by Abraham Trembley.

Since that time the family Stentoridæ has become familiar to most workers of the microscope, the Stentors or trumpet ammalcules are so characteristic that when once seen could hardly be forgotten; the nine or ten species known, although varying in size and form, all have essentially the trumpet shape. Our species is *S. Niger*, and at first, when seen under the microscope, was decidedly disappointing, the intense black pigment permeated its substance and precluded all chance of seeing details of structure. After keeping a number of these organisms in some clean water for a week, they presented a clearer appearance, and in about three weeks they had almost entirely altered their complexion from black to green.

For the benefit of our readers who may happen to be novices at the study, we will give a brief description of Stentors. This organism belongs to the division of the animal kingdom, *Infusoria*, being covered with fine hair-like processes or cilia, hence Ciliata class; the cilia are of two kinds or systems, some extra fine and short, covering the whole body, others longer, coarser, and arranged round the oral or mouth end; further, then, it comes under the order Heterotricha; and lastly they are Stentors or trumpets. *S. Niger* is about the 1·20th or 1·50th of an inch in length, its mouth end is broad, tapering, but not regularly, to the posterior end, where it becomes oval or more or less pointed. They attach themselves by this extremity when living *en masse* as they frequently do, the social condition being strengthened by a mucilaginous development excreted from their bodies, and by myriads, in an adjoining pond to the one described above, we found them pendant to decayed submerged plants. *Stentor Niger* is exceedingly flexible, and the shape very variable; the sarcode or animal protoplasm which forms the substance of its body, has been differentiated into an outer cortical layer of a striated character, and the cuticular surface covered with cilia noted above. The endoplast or nucleus with its nucleolus is rounded in *niger*, but varies much in form in other members of the genus; it occupies a position in the outer layer or ectoplasm. In contrast with this darker body there is a larger, round, clear-looking part, the contradile or pulsating vesicle. This pulsating vesicle is connected with a number of underlying clear-looking vesicles, which, by the way, were mistaken by that able and patient observer Ehrenberg for food vacuoles, hence he called these animalcules "polyastrica," *i.e.*, many stomached animals; they are not, however, digestive, but probably excretory in function. The oral aperture at the broad end is simply a channel in the sarcode at a particular point, primitive enough, but it foreshows that more elaborate structure known as a mouth. It is guarded by some of the longer and stronger cilia, which, in fact, forms the vortex or termination of the circlet of cilia which surrounds that part of the anterior end called the peristome.

When Stentor is feeding it is at this point that the food particles, chiefly minute unicellular plants, are seen to be driven and drawn, after having been whirled furiously many times round by the cilia of the peristome. Passing through the excavated part of the sarcode (the gullet), the food having reached the bottom, it is passed onward, and simulates a kind of circulation down and up and around the interior; during this time nourishment is abstracted by the sarcode, the innutritious portion is cast out by an extemporised anal outlet, always just below the peristome. The pulsating vesicles already noted may be seen to open gradually and close rather quickly; these may have either function as excretory to get rid of surplus water and waste matters, or as respiratory carrying water containing oxygen to all parts of the active body substance.

These animalcules multiply usually by fission or splitting, which is longitudinally or obliquely in this genus; in other forms of the *Infusoria*, transversely. In any case the endoplast, or nucleus, takes an initiative step in the process, in certain cases becomes the starting point of germs which are thrown off. There is also the question of the blending of two similar Stentors, and the regeneration of the nucleus of each, which is asserted by some writers. This is followed by encystment and the more rapid production of zooids, which very readily acquire the characters of the parent. Although much careful and critical observation has been made in reference to the reproduction of the *Infusoria*, many points of much interest require to be more thoroughly worked out, and very much more requires to be reinvestigated.

We have always felt that there is real pleasure and much profit in labouring to confirm the investigation of other workers, although nothing new may directly result. Students of biological science are too apt to be content with the mere statement of others; observations made a long time ago require to be observed again, and every student will be the better for knowing, as far as possible, what is and what is not, for himself. We do not for a moment think that the appearance of this enormous number of *stentors* under the conditions we have above described is a phenomenon which has not been observed before, but we venture to hope that the readers of "Research" will consider it of sufficient interest to deserve attention. W. NARRAMORE.

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A NEW TECHNICAL SCHOOL is to be erected at Dewsbury at a cost of about £5,000. This school is one of the outcomes of the jubilee celebrations in that town, and in it complete provision will be made for teaching, in as perfect a manner as a capable staff of instructors with the best apparatus at their command can do it, the arts of cloth weaving, designing, and dyeing, and instruction will also be given in the ordinary science and art subjects. There will be evening classes in all these branches of technical and scientific education, and probably day classes too, and facilities will be afforded for the attendance of scholars connected with the local elementary schools, who will have all the advantages of theoretical teaching and practical demonstration at a merely nominal fee.

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Ornithological Notes.

The Buzzard.

WE are favored by Mr. CHARLES POTTER with the following interesting note :—

Some misguided persons gloat over the fact of a rare and almost extinct bird having been killed, but to my mind the fact of any species of naturalised bird or animal being wiped out of existence is strongly to be condemned. I therefore note with regret that at Hummer Wood, East Grinstead, a very fine specimen of the very rare Honey Buzzard *(pernis apivorus)* was recently shot. This bird generally feeds on the larvæ of bees, hence its name, but this specimen had made a recent meal of the larvæ of moths and butterflies, its ordinary food being scarce this year. A specimen which I obtained in the same county had its crop of stomach filled to the greatest extent with the large larvæ of the Drinker and Egger moths. From an extensive series of observations, I consider these larvæ to be the natural food of the Buzzard, when the larvæ are obtainable, in this country.

With regard to the report of a specimen of the "rough legged Buzzard" having been recently trapped in Wyresdale, Yorkshire, Mr. POTTER, writing to the *Liverpool Courier*, states :—

As an old student and successful collector of British birds in the South-east of England, I would congratulate the owner of the rough-legged Buzzard *(buteo lugopus)* in possessing a very rare British bird, which certainly is not more common in the southern and eastern counties than in the northern. Yarrell says of this rare Buzzard that it has seldom been known to breed here, and is usually obtained in the spring or autumn, when changing its latitude from south to north, or *vice versâ*. The predatory habits of the falconidæ would render the finding of them in flocks almost an impossibility.

Extermination of Birds in the Lake District.

The wanton destruction of members of the feathered tribe should be more severely dealt with by magisterial jurisdiction. An action was recently heard at the Kendal Petty Sessions, where a man was charged under the Wild Birds' Protection Act with shooting a dotterel during the close season. Mr. JOHN WATSON, author of several works on natural history, said that the bird produced was a male dotterel just assuming the green feathers. They were becoming exceedingly rare in the country, owing to destruction for their feathers. They bred on the tops of mountains, such as Skiddaw and Scawfell, and in their own neighbourhood they were occasionally to be met with at Kentmere and Longsleddale. The Bench imposed a penalty of £1 and 14s. 6d. costs, or in default fourteen days' imprisonment.

The Nightjar.

It may, perhaps, interest our readers to know that one of our latest summer migrants, the Nightjar, has arrived, and that a specimen was seen on the sandhills between Southport and Ainsdale on Monday, May 21st. A correspondent states :-

"As it was early in the afternoon, we had a good opportunity of identifying it. When disturbed it flew languidly a few yards, and then alighted. It would be interesting to know if its arrival has been noticed elsewhere. I may also state that the Stockdove seems particularly numerous on these hills, as we found several nests, all of which had eggs in. Wheat-ears were also plentiful, and were busy nesting."

Societies.

MANCHESTER GEOGRAPHICAL SOCIETY.—The last issue of this Society's journal, edited by the secretary, Mr. Sowerbutts, includes the period from July to December, 1887, and completes the third volume. It contains papers on Railways between Burmah and China, the Ruby Mines of Burmah, the Trade of Formosa, and very much valuable information respecting Borneo, Manchuria, and many parts of Africa. It is a decidedly valuable contribution to geographical and commercial literature.

THE British Association for the Advancement of Science will hold its 58th meeting, commencing Wednesday, the 5th September, at Bath, the President-elect being Sir Frederick J. Bramwell, D.C.L., F.R.S., M.I.C.E.

SOCIETY OF CHEMICAL INDUSTRY.—This Society will hold its annual general meeting in Glasgow on July 4th, 5th, and 6th. The morning of the first day will be occupied in receiving reports of the Council and Treasurer, election of office-bearers, address by the President (Professor James Dewar, M.A., F.R.S), and some miscellaneous business. The afternoon is to be left free for the members to visit the International Exhibition, and in the evening the annual dinner will take place at the Grand Hotel. The second day will be devoted to several excursions to Forth Bridge Works and Broxburn Oil Works, Thornliebank Print Works, the Langloan and the Summerlee Iron Works, Messrs. J. & G. Thompson's Shipbuilding Yard, Singer Company's Works, the Glasgow Cleansing Department Works, and the important works of Messrs. Nobell. On Friday Messrs. Walker & Co.'s sugar refinery at Greenock will be visited, and afterwards a cruise will be made on the Firth of Clyde in the steamer Victoria.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—The Congress will meet in the Rooms of the University of London, Burlington Gardens, from the 17th to the 22nd of September. The opening meeting will take place on Monday evening, September 17th, at 8 p.m., when the Council will be appointed, and the general ordinary business of the session will be determined. The ordinary meetings will be held on the mornings of Tuesday, the 18th, and succeeding days, commencing at 10 a.m. In the afternoons there will be visits to museums, or to places of interest in the neighbourhood of London. Excursions to the Isle of Wight, North Wales, Yorkshire, and other places will probably take place. An exhibition will also be held, to which geologists are invited to send maps, recent memoirs, rocks fossils, &c.

ROYAL METEOROLOGICAL SOCIETY.—June 20. Dr. W. Marcet, F.R.S., President, in the chair. The following papers were read :—1. On the Photographs of Lightning Flashes, by the Hon. R. Abercromby. He pointed out that the zig-zag form depicted by artists is evolved from their inner consciousness, as it is absent from the many photographs which were exhibited. In the ensuing discussion Sir W. Smyth related his recent thrilling experience in a room wrecked by lightning as he sat in it, and Mr. Symons, F.R.S., expressed a doubt as to the validity of the excessive rate of travel attributed to lightning. 2. On the Cold Period from September, 1887, to May, 1888, by Mr. C. Harding, in which he showed that the mean temperature over our islands during the nine months was below the average, and that October has never been so cold during the last half century. The mean temperature in London for this period was only 42°, and we have had no such continuous cold at this time of the year since 1854-5, which will be remembered as the winter of the Crimean War. At Greenwich the temperature of the soil at a depth of three feet was below the average from October to April. Some months were the lowest at this depth for the past forty-two years. The bearing of temperature upon the growth of vegetation was also considered, and it was demonstrated that the effective heat in all the United Kingdom was decidedly below that of any of the last ten years. This persistent low temperature has hardly left us yet. 3. Observations on Cloud Movements near the Equator, and on the General Character of the Weather in the Doldrums, by the Hon. R. Abercromby. This paper was based upon data obtained by the writer while crossing the Equator as passenger in steamships. He said that Maury's theory of the currents of air above the N.E. Trade was shown to be incorrect. Mr. Abercromby's observations are, however, too few to be of much value, and, moreover, a landsman on board a swiftly-moving vessel is at a decided disadvantage. Captains Barker, Maclear, Toynbee, and Mr. C.

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Harding took part in the discussion, and the consensus of opinion was in favour of inviting seafarers to take careful observations of upper cloud directions in the regions of trades and monsoons.

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MANCHESTER MICROSCOPICAL SOCIETY.—The Society's annual volume for 1887 has been issued, and shows that the Society is doing good, useful work. It contains the address of the President, Professor Milnes Marshall, F.R.S., on the Recapitulation Theory; a lecture on the structure and life-history of the Ascidian; and about twenty papers by the members on lichens, zoolites, parasites, saccharine, the lantern microscope, the crayfish, and similar subjects. Several of the communications are illustrated, and the frontispiece is a portrait of Dr. John Tatham, the officer of health for Salford, who has been twice president of the Society, namely, in 1880 and 1885.

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THE YORKSHIRE NATURALISTS' UNION.—A meeting of this Society was held on Saturday, the 16th of June, in the Saddleworth district, and the results appear to show that as an expedition for scientific research the district was well chosen, and that the members present were active in making the opportunity one of real study. The members divided themselves, for the purposes of their explorations, into two parties, one devoting itself more especially to geological researches, and the other to botanical and entomological enquiries. The former proceeded over Harrop Edge, which is topped by the Kinder Scout grit. Regarding the geological features of this district, Mr. Percy F. Kendall, of Owens College, says that the Saddleworth district affords an excellent illustration of a geological inlier. The Yoredale rocks and the overlying millstone grit have been thrown into an anticlinal fold running in a general north and south direction, but complicated by minor undulations at right angles. From the summit of the ridge the millstone grit has been removed, exposing the Yoredales. The Yoredale series consists of shales and grits, the former containing intercalated bands of black limestone which are often crowded with goniatites, orthoceras, and other fossils. The anticlinal axis coincides roughly in position with a fault of small throw, but extending to a distance of about twelve miles, and many smaller, sub-parallel faults traverse the adjacent country, one of them crossing the village of Saddleworth. The millstone grit completely encircles the Yoredales, and rises on the north and east into a series of flat-topped hills, presenting the features of moorland scenery so characteristic of the formation. About two miles north of Saddleworth is an outcrop of coal occurring as a lenticular seam in the millstone grit." From Diggle Station, the party walked over Harrop Edge. Here Mr. Watts, F.G.S., opened some specially prepared maps showing the contour of the country, and described the different elevations. In the distance was seen the escarpment from which many of Professor W. C. Williamson's best fossils have been obtained in the upperfoot coal. They next passed by the Roman Station at Castleshaw, resting a moment to admire the beautiful mullioned windows of Castleshaw House, and went by the new waterworks to Cudworth Quarry, where the Kinder Scout is again encountered. After an examination of the quarry, the geologists walked up to the top of Noddle, where they were met by Mr. Morgan Brierley, who gave a capital description of the surrounding scenery, which includes Hartshead Hill, near Ashton, the highest of the series on the Yorkshire side, Lurden, and other elevations. Proceeding to Mr. Watts' office, they were shown specimens of the travelled rocks, which had been taken from the drift during the excavations made for the new reservoirs. An interesting explanation was given of these rocks, which include not only Scotch granites and lake district volcanic rocks, but even a fossil from the lias, which formed the subject of a little discussion. In viewing the puddle trenches which have been made for the lower Castleshaw Reservoir they came upon some good specimens of laminated marl. The entomologists obtained specimens of the *Shoxopteryx myrtillana*, *Larentia didymata*, *Hypsipetes elatata*, *Hadena glauca*, *Clepsis rusticana*, and several good species of *Neuroptera;* whilst the notes on vertebrate zoology included observations of the grouse, cuckoo, ring-ousel, water-ousel, pied wagtail, and wheatear. The botanical party in the course of a pleasant, though somewhat toilsome walk, obtained a large number of specimens, the principal specimens of phanerogams being the crowberry, the cloudberry, cowberry, a rare form of cotton grass *(latifolia)*, hares-tail cotton grass, the bog violet, the French willow plant, the square-stalked willow herb, the pill-headed gedge, the large flowered bitter-cress; and the oak, bladder, and mountain buckler ferns. Of cryptogamic forms, those found were taken home for subsequent examination.

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THE LIVERPOOL MARINE BIOLOGICAL COMMITTEE.—Professor W. A. Herdman, F.R.S.E., &c., of University College, Liverpool, has described in *Nature* the use which was made of the electric light for collecting after dark during a cruise of the Liverpool Marine Biological Committee. "On the first night, in Ramsey Bay, after the shore party had left and the ship was anchored for the night, an electric light of 1000 candle-power was hoisted a few feet above deck, and this allowed work to be carried on almost as comfortably as during the day. Captain Young, of the Liverpool Salvage Association, who was in command of the *Hyæna*, then kindly arranged for me a 60 candle-power Edison-Swan submarine incandescent lamp in the mouth of a tow-net. This illuminated net was carefully let down to a depth of three fathoms, and allowed to remain there for half an hour. At the same time, another tow-net without any light was let down to the same depth over the opposite side of the ship. When the nets were being hauled in, as the one with the electric light approached the surface numerous small animals (Crustacea probably) were noticed accompanying it, and darting about in the bright light. This tow-net, when emptied into a glass jar of sea-water, was found to contain an abundant gathering, consisting mainly of Crustaceans; while the net in the dark on the other side of the ship had practically nothing. The two nets were then put out again. The one had the electric light in its former position, but this time it was let down to the bottom at a depth of six fathoms; while the other net was placed in the dark at the ship's stern, and also reached the bottom. The tow-nets remained stationary, but were kept distended by the tide. The outline of the illuminated net could be made out indistinctly at a depth of six fathoms. After being out for three-quarters of an hour both nets were hauled in, with the same result as before. The illuminated net contained abundance of Crustacea (chiefly Amphipoda, Schizopoda, and Cumacea), while the dark net again contained practically nothing. These two experiments showed pretty conclusively the effect of the brilliant light in attracting the free swimming animals, the difference between the contents of the two nets being on both occasions most marked. Consequently, on the second night, in Port Erin Bay, *both* nets were illuminated, and while the one was let down close to the bottom, at a depth of five fathoms, the other was kept at the surface of the sea on the opposite side of the ship. This experiment was tried three times, with the same result each time: both the nets were found to contain abundance of animals, but the bottom and surface gatherings differed greatly in appearance and in constitution. The net from the bottom contained mainly large Amphipoda and some Cumacea, while the gathering from the surface was characterized by the abundance of Copepoda. As Mr. A. O. Walker, who is reporting upon our higher Crustacea, pointed out to me, the Amphipods from the deep net appeared to be chiefly red-eyed species, such as *Ampelisca lævigata* and *Bathyporeia pilosa*. If this, on a detailed examination of the material, turns out to be the case, it may indicate an interesting relation between the colour of the eyes and sensitiveness to the electric light. Mr. I. C. Thompson has already identified many species of Copepoda from the illuminated surface net,

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including—*Calanus finmarchicus, Pseudoca'anus elongatus, Dias longiremis, Idya furcata, Centropages hamatus, Anoma'ocera patersonii, Isias clavipes, Oithona spinifrons, Harpacticus chelifer*, and *Harpacticus fulvus*. The specimens of the last two species are remarkable for their unusually large size and their abundance."

LIVERPOOL NATURALISTS' FIELD CLUB.—The third field meeting of the present session was held at Ingleton on Wednesday, June 13th. Leaving Exchange Station, Liverpool, at 9-45 a.m., a party of about ninety members and friends proceeded *viâ* Hellifield, where lunch was partaken of, and on arrival at Ingleton a start was at once made for the delightful valley of the Greta. A heavy shower of rain having fallen during the morning, the splendid waterfalls of this district were visited under very favourable circumstances. The Greta was followed past the Pecca Falls to Thornton Force and Raven-ray, and then a course was taken across the moorland of Twistleton Scar to the Beesley Falls, on the Doe, and this river was followed, passing the Baxengill Gorge and several minor falls, to Ingleton Dinner-tea was served at the Ingleborough Hotel, and was heartily enjoyed after a six miles' walk among some of the most romantic scenery in England. Plants were not numerous, but many interesting kinds were found, including the wild lily of the valley, herb-Paris, the globe-flower (*Trollius Europæus*), the Welsh poppy, the mealy primrose (*Primu'a formosa*), and several rare ferns. The order prize, for Geraniaceæ and Caryophyllaceæ, was taken by the Rev. S. Gasking, with ten species; the prize for the three rare plants was awarded to Miss E. M. Wood for *Trollius Europæus, Meconopsis Cambrica*, and *Paris quadrifolia*; that for collecting the largest number of plants in flower was gained by Miss Cecilia Lane; the prize for the best basket of wild flowers was given to Mrs. Waugh; and the botanical enigma was solved by Mrs. E. Davis, Mrs. Bodell, Mrs. Waugh, Miss T. Mackarell, Miss Clementson, Miss E. M. Wood, the Rev. S. Gasking, and Misses Wardell, Price, and Mackarell, the plant being *Geranium molle*.

LIVERPOOL GEOLOGICAL ASSOCIATION.—On Monday, June 11th, the Members of this Association, under the guidance of Dr. C. Ricketts, F.G.S., visited Flaybrick Hill, Birkenhead, to inspect some sections exposed by the recent quarrying operations. Special interest is attached to the examples of Glacial Action, here very abundant. The superficial beds of sandstone and pipeclay seem to have been roughly dealt with, and large quantities of rubble ground up by the ice and left in superficial hollows of the rock make it very difficult to tell where the trias ends and the boulder clay begins. Glacial striæ are still to be seen at one spot, and they seem to indicate, when taken in conjunction with other local evidence, that the movement of the ice which produced them was from north to south.

THE LIVERPOOL AND DISTRICT ASSOCIATION OF SCIENCE AND ART TEACHERS—At the last meeting, the members discussed form 290 of the Science and Art Department, concerning the changes to be made in the next edition of the Science and Art Directory, and passed the following resolutions:—*Science and Art, Form 290. Referring to Paragraph 1:* That successes in Geometrical Drawing (1, Sect. 1) be divided into two classes, good and excellent, and that payments of 10/ and £1 be made respectively for them. *Referring to Paragraph 2:* Seeing that the course of instruction in new subject, Elementary Physics, cannot be sufficient to qualify a Student for the Advanced Class of either Subject VIII. (Sound, Light and Heat) or Subject IX. (Magnetism and Electricity), and that to continue his studies in these subjects, he would require to pass through the Elementary Classes thereof. We recommend that the scheme of payments should be such as to induce teachers to undertake the elementary instruction of such students; that is to say, that in the case of a student who has obtained a first-class in the new subject, Elementary Physics, any subsequent claim for payment in the Elementary Stage of Subjects VIII and IX. be reduced by £1 in each subject. In the case of a student obtaining a second class in Elementary Physics, the reduction to be 10/- in each subject. *Referring to Paragraph 3:* Considering the recognized importance of a knowledge of Machine Construction and Drawing as an essential basis of most branches of Technical Education, and, feeling from experience the disability that many students suffer under from a lack of such knowledge, we think that the study of this subject should be encouraged, and we, therefore, recommend that the regulation of paragraph 3—"Payments will not be made on account of the same pupil in any one year in more than two subjects other than Subject I. (Practical, Plane and Solid Geometry) and Subject V. (Mathematics) be modified by including Subject II. (Machine Construction and Drawing) along with Subjects I. and V. On the 9th of June, this Association, under the leadership of the President, Mr. Edward Davies, F.I.C., F.C.S., visited the Manchester Ship Canal Works at Eastham, and there examined the several portions of the works, the arrangements made for housing the workmen, &c. They were specially interested in watching the operation of the steam navvies, which, in works of this kind, bid fair to supersede much manual labour. They returned by a country route through fields and Bromboro' Woods, obtaining upon the way many botanical specimens.

LIVERPOOL SCIENCE STUDENTS' ASSOCIATION.—A large party of members and friends recently visited West Kirby and Hilbre Island. On arrival three sections were formed—a botanical party, under the direction of Miss E. M. Wood and Mr. James Mackarell, proceeding to Caldy; the biological and geological sections, under the guidance respectively of Messrs. W. Narramore and I. E. George, making their way across the sands, first to the Little Eye, thence to Hilbre Island, for the study of the sandstone formations and interesting fauna of this happy hunting ground of local naturalists. The fine weather experienced proved highly favourable to the botanists, upwards of ninety-two plants in flower being obtained. Among the more interesting specimens found were *Thalictrum minus, Sedum Anglicum, Ornithopus perpusillus*, and *Armeria maritima*. The prize for the day was offered for the best named collection of plants in flower belonging to the order *compositæ* and *rosaceæ*, and after a keen competition it was awarded to Miss M. E. Clementson, who obtained twenty-two species. The geological features of the island were explained by Mr. Isaac E. George, who, in the course of his remarks on the peculiar "weathering" of the rocks, alluded to the great denudation that had taken place during the last century. Owing to the lateness of the hour when the biological party reached the northernmost and richest part of Hilbre Island, the collections made were not so large as expected, but the abundant marine forms of life, which were discovered on the rocks and in the various pools round the shores, gave promise of much good work being done when time would permit a more extended examination of this interesting neighbourhood.

Review.

Quarterly Journal of the Geological Society. [Vol. xliv., Pt. 2.]

THE May number of this Journal is usually of exceptional interest, containing, as it does, the proceedings of the Annual Meeting and the Anniversary Address of the President. This year, the Address compares very favourably with the presidential discourses of recent years. Having previously expatiated upon the intimate relations now growing up between the sciences of geology proper and mineralogy, Professor Judd now

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proclaims that such a result should in no way involve any interruption of the close relations which have so long subsisted between geology and biology. Whilst so much attention has of late years been directed to the physical aspect of the science, it should not be forgotten that it was in the domain of Palæontology that the earlier successes of geological discovery were achieved. Professor Judd stands as one who regards palæontology as the borderland of the geological and biological sciences,—a borderland where "the cultivators of both ought ever to meet, not for rivalry and aggression, but for the necessities of intellectual commerce, and the advantages of mutual help." This part contains some other valuable contributions, amongst which may be mentioned papers by Mr. A. S. Woodward on lepidotoid fishes from South Africa; Professor Boyd Dawkins on a new carnivore from the Red Crag; Mr. C. Davidson, on movements of scree-material (relating to minute movements in loose stones, caused by alterations of temperature); Professor Blake, on the Cambrian and associated rocks of Carnarvonshire; and Mr. H. Fox, on the gneissic rocks off the Lizard. One of the most interesting of all, however, is a paper by Mr. T. Mellard Reade, of Liverpool, on "An estimate of post-glacial time." It has always been one of the difficulties of geological teaching to give a reliable idea of geological time. The mind is appalled with the vast ages assumed by the geologist to be necessary for his earth-changes, and for the deposition of the rock-formations of the earth's crust. Mr. Reade shows, however, that with regard to recent deposits and subærial accumulations now in progress, it is possible to calculate the rate of their formation by means of careful observations extending over a definite period, and estimates which are not altogether without value may be obtained by determining the amount of solid matter brought down by rivers and re-deposited in the bed of the ocean, He estimates that the extensive series of deposits, all posterior to the glacial period, ranging along the coasts of Lancashire and Cheshire, represent a lapse of time of not less than 57,500 years. This number is arrived at from a variety of considerations, forcibly adduced by Mr. Reade, to which the attention of geologists is now being directed. It is allotted as follows:—40,000 years for the elevation succeeding the glacial period measured by the time occupied in clearing out the boulder clay in the valleys of the Mersey, Dee, and Ribble; 15,000 years for the accumulation of the estuarine silts, clays, and peat beds, and 2,500 years for the blown sands. These investigations can hardly be regarded as final, seeing that our knowledge is ever increasing; but they afford indication that actua time measurements of physical operations are not altogether impossible of attainment. J.

Museum Notes.

After some years of seclusion in private rooms, rarely visited except by a few students and distinguished strangers, the celebrated Phillips' Collection of Minerals in the Liverpool Free Public Museum has been re-arranged and opened to the public. The collection was originally formed by the eminent mineralogist whose name it bears, prior to the year 1820. The city owes this valuable series of minerals to the generosity of the Medical Institution, from whose possession it was removed some years ago to William Brown Street. The series is especially rich in samples of Cornish minerals, some of which are from localities now closed to investigation, and are almost unique. Mr. F. P. Marrat has arranged the specimens in the cases, following as far as possible the original order as laid down by William Phillips himself.

Mr. W. Eagle Clarke, F.L.S. (one of the editors of the *Naturalist*), has been appointed Senior Assistant at the Museum of Science and Art Edinburgh.

The Manchester Museum.—The Museum at Owen's College is now open to the public on Mondays, Tuesdays, and Saturdays, from 11 a.m. to 6 p.m. Persons other than students of the College and members of the Geological Society will also be admitted on Wednesdays and Thursdays, between 10 a.m. and 4 p.m., on presentation of a ticket of admission, to be obtained from the Curator. The entrance is by the door of the Beyer Laboratories in the north-east corner of the quadrangle.

A new arrangement of fish and reptiles has also been completed in an additional room at the Liverpool Museum, and the collection, as now presented, is much enhanced as regards its educational value.

At the Owen's College, Manchester, the labour of re-arranging the extensive Geological Museum, necessitated by its removal to the new building, proved more serious than had been anticipated. The collections, which are well designed to illustrate the leading facts of palæontology and geology proper, have now been completed under the direction of Professor W. Boyd Dawkins, M.A., and Mr. Percy F. Kendall, and are opened to the public on certain specified days, as stated below.

Outside the College walls, in the quadrangle, a kind of external Museum, or "outlier" of the general collection indoors, is afforded by the heaps of specimens of huge boulders, some beautifully striated, large blocks of peculiarly weathered rocks, and specimens adapted by their size for out-of-door exhibition. Amongst these must be noted the giant 30-ton boulder discovered in some sewerage operations in the Oxford Road, which is picturesquely made to occupy a special pedestal of its own on one side of the quadrangle.

The town of Northwich is to have a Museum of unique character, and one that is quite in accordance with the position it occupies in the centre of the salt industry of Cheshire. This Museum will contain specimens of salt from all the known salt deposits of the world, a library of works relating to the subject in all languages, also plans, maps, and diagrams relating to saliferous regions. Mr. Thomas Ward (the author of an extensive literature on questions relating to salt) is the instigator of this useful scheme, and, as he is a man of energy and resource, there is little doubt that it will be carried to a successful issue.

Recent additions to the Grosvenor Museum at Chester include several rare specimens of *Lepidoptera*, by Mr. F. Archer, Mr. Siddall, and Mr. Leather; of *Coleoptera*, by Mr. Denson, Mr. A. O. Walker, and Miss Calcott; *Birds*, by the Duke of Westminster; and of *Fish*, by Mr. Walker and Mr. Guy. Amongst these is a fine specimen of that rare fish, the Greater Forked Beard *(Physis furcatus)*, which was captured by Mr. Parry Evans at the Weir at Rhos, Colwyn Bay, in April last.

An agitation has been commenced for the formation of an Association of Museum Curators, or those engaged in active work on Museums. At a special meeting of the Yorkshire Philosophical Society, it was decided to form such an Association, which will be able to consider many practical questions of importance relating to the management and arrangements of many of our Museums, some of which are, it must be confessed, in a chaotic state.

Science and Art Examinations in Liverpool.—At the recent examinations held in Liverpool under the Science and Art Department, the number of Candidates in the different subjects was as follows:—Third Grade Art—Shading from Models, 31; Outline from Cast, 44; Shading from Cast, 35; Anatomy, 2; Sciography, 1; Perspective, 9; Composition—Figure Subject, 7; Drawing from the Antique, 15; from Life, 16; the Antique from Memory, 3; Painting in Monochrome, 15; Painting, Still Life, 15. Second Grade Art—Model Drawing, 349; Freehand, 592; Geometry, 313; Perspective, 176. Practical, Plane and Solid Geometry, 57; Machine Construction and Drawing, 158; Building Construction, 69; Naval Architecture, 1; Mathematics, (in seven stages), 702; Theoretical Mechanics, 236; Applied Mechanics, 100; Sound, Light and Heat, 63; Magnetism, and Electricity. 413; Inorganic Chemistry, (Theoretical), 517; (Practical), 199; Organic Chemistry, (Theoretical), 25; (Practical), 9; Geology, 46; Mineralogy, 3; Animal Physiology, 205; Botany, 115; Biology, 5; Metallurgy, (Theoretical), 14; (Practical), 8; Navigation, 5; Steam, 84; Physiography, 576; Principles of Agriculture, 61; Hygiene. 52. Total Papers Worked, 5,550. Total number of Students under Instruction in Liverpool, 5,690, viz:—In Art, 1,987; in Science, 3,703; being a considerable increase in the number of papers worked, but showing little difference in the attendance on the classes.

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Research:

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NOTICES.

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Remittances and Communications respecting Advertisements, should be addressed to C. BIRCHALL, 32, Castle Street, Liverpool.

Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

No. 1 PORTRAIT.—We omitted to mention in our first number that the portrait of the Rev. H. H. HIGGINS was from a photograph by Robinson & Thompson, Liverpool.

We regret that owing to pressure on our space we have to leave over till next month reports of meetings of the Warwickshire Field Club, the Severn Valley Naturalists' Field Club, and other societies, and also several reviews.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Notes and Comments.

TO OUR SUBSCRIBERS AND FRIENDS.—We have received from many parts of the country gratifying expressions of approval of the programme we laid down in our first number; and we gratefully acknowledge the many efforts which friends have made in many directions for promoting the success of *Research*. We note, however, that some consider that our magazine is to be entirely of a local character, confined to Liverpool and neighbourhood; but, whilst giving details of local scientific progress, we certainly do not intend to restrict our survey to any one special locality, but shall endeavour to collect scientific news from all quarters, and give insertion to articles, &c., of general scientific interest, and carefully keep before our readers the relation of science to original research, and its bearings on industrial progress and ordinary education. We particularly desire to give a careful digest of the work of the many scientific societies in different parts of the country, for in reading through the very numerous reports already received we have been particularly struck with the large amount of valuable work done by these societies. Indeed, so numerous have been these reports that it has not been possible in our present issue to do full justice to them, or even mention all that have been sent to us, but we trust in future numbers, to deal with them so as to put before our readers all items that are of value.

THE TECHNICAL EDUCATION BILL.—The Government have dropped the Technical Instruction Bill for this session. Although it is to be regretted that legislation on so important a subject is deferred for another year, there were several serious objections to the provisions of the late Bill, and it certainly is desirable that public opinion should be better educated than it is as to what is meant by technical education. Even amongst those who now ask for legislation in this direction, there are many who hardly know what they want, and therefore it is well that there should be longer time for discussion. The National Association for the Promotion of Technical Education, with its branches and co-operating associations, may be trusted to disseminate useful information and promote discussion of the subject; but all who take interest in educational matters should thoroughly well consider the subject from their special standpoints, and confer as to the best means of making our educational systems practically and technically useful.

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THE MARINE BIOLOGICAL LABORATORY AT PLYMOUTH.—One of the most interesting occurrences of the past month was the opening of the Laboratory of the Marine Biological Association at Plymouth by Professor Flower, C.B., F.R.S., in the presence of a distinguished gathering of scientific men. The laboratory is the first of the kind established in this country, and is the outcome of a movement initiated at a meeting held in the rooms of the Royal Society in 1884, when the Association was formed. The Prince of Wales became patron, with Professor Huxley as president, and many leading scientific men were appointed vice-presidents and members of the Council; Professor E. Ray Lankester, F.R.S., of University College, London, being the secretary, and Frank Crisp, Esq., vice-president and treasurer of the Linnæan Society, treasurer. A perusal of the Journal of the Association, No. 1, which contains the report of the foundation meeting, the report of the Council, a description of the laboratory, and notes on the fishery industry of Plymouth, shews very clearly the great advantages that can arise from the work of such an Association.

THE "RIGHT OF WAY" AND ITS RELATION TO SCIENTIFIC FIELD-WORK.—The Latrigg case, heard at the Cumberland assizes at Carlisle early in July, should call the attention of Secretaries of Naturalists' Field Clubs and officers and members of other societies who wish to study science "out of doors," to the fact that attempts are being made in many directions to close up paths that lead to localities where scientific students can find much to interest and instruct them. The Keswick and District Foothpath Preservation Association deserve the thanks of all who are interested in scientific field-work, in the stand they made against the closure of roads to the Latrigg Mountain. Scientific Field Clubs and similar societies should watch with jealous eyes every attempt to close public footpaths.

THE WANTON DESTRUCTION OF RARE PLANTS.—But whilst advocating free pathways for scientific field-work, we cannot help calling attention to the wanton destruction of rare plants and the thoughtless removal of other objects of scientific interest that now frequently occur. Not that we think the members of scientific societies are, as a rule, reckless or thoughtless in this respect; but there can be no doubt that many rare plants, for example, are every year being removed from localities in which they flourish with reckless disregard as to their perpetuation. The July number of the *Argosy*, in an article on "A Plea for Wild Flowers," deals with this destruction of valuable plant specimens, and calls attention to a society established at Geneva under the title of "Association pour la Protection des Plantes," the objects of which are two-fold—first, that of disseminating useful information on the subject of the Alpine Flora; and second, the undertaking to supply seedling specimens of all the different varieties at prices much below those usually extorted by the present hawkers. Similar work may well form part of the programme of our own Naturalist Societies and Field Clubs. We do not forget that the Selborne Society has already done good work in the direction of preventing reckless plant destruction.

THE STUDY OF LICHENS AND FRESH WATER ALGÆ.—A correspondent writes as follows:—If co-operation in the study of lichens and fresh water algæ could be met with from any of your readers, I would gladly avail myself of it." We willingly mention this, because we well know that amongst those who give attention to botanical studies, only a comparative few are found working in earnest at cryptogamic botany. We trust the desire of our correspondent may meet with such response as will lead to further studies in this most interesting department of botanical investigation. We shall be glad to receive communications on this subject.

Local Museums.

II.—Chester.

UNTIL two years ago, it was known only to a somewhat limited section of the public that the city of Chester (the "rare old city," as Albert Smith was wont to call it) possessed any museum at all worthy of a district so rich in archæological interest and presenting so many opportunities for natural history studies. Yet, the initiated few knew that in a small building used by the Natural Science and Archæological Societies in Lower Bridge Street, were stored, in rough-and-ready fashion, it is true, collections of considerable value illustrating the work of these two societies. It is unnecessary here to dwell upon the disadvantages of the scanty accommodation afforded to these collections. The Roman stones were to be seen in a low and dark passage which formed the entrance to the building, and if the natural history portion had the best of the space, that space was itself far too limited to allow of the necessary developments to be looked for in a community which had ever shown a remarkable zeal in scientific pursuits. It soon, therefore, became evident that the accommodation was totally inadequate, and in 1882 the movement commenced for the establishment of a new and central institution, to include Museums of Archæology and Natural History, as well as Schools of Science and Art, which resulted in the erection of the present handsome edifice known as the "Grosvenor Museum." A portion of the site for the building was generously presented by the Duke of Westminster, who also headed the subscription list with a sum of £4,000, afterwards increased to £5,100. The total cost of the museum buildings was over £11,000, nearly the whole of which has been raised entirely by local effort. On the 3rd February, 1885, the ceremonies in connection with the laying

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of the foundation stone took place, and on the 9th August, 1886, the building was formally opened to the public.

Chester now possesses a Museum and School of Science and Technology which is not only a credit to the city from an architectural point of view, but is a standing monument to the energy and zeal shown by its citizens in the furtherance of higher education as adapted to modern needs. The citizens of Chester have faithfully preserved the historic traditions of the past, whilst actively inculcating true principles of progress as a guide for the future. Much of this excellent spirit is, no doubt, due to the teaching and presence in their midst of such men as the late Charles Kingsley, Dean Howson, and John Price, who have left enduring records of their influence in this neighbourhood. The Chester Society of Natural Science (which enjoys a most successful career, numbering no fewer than 619 members on its roll) was founded by Kingsley in 1871, previously to which there existed a smaller local society of scientists. This was known as the "Chester Natural History Society." It was founded in April, 1858, and survived until 1860. The earlier members included Mr. J. Price ("Old Price"), Dr. Churchill Watson, Mr. G. W. Shrubsole and Mr. Alfred O. Walker, all of whom either are, or were, active in connection with the existing Society. The Archæological and Historic Society, being the senior, should perhaps have received first mention. Its origin dates back to 1849, at which time a small collection of antiquarian relics found a resting place in an old cupboard in the Commercial Buildings. This society has done much work in its time, a large share in its labours having been undertaken by Mr. Thomas Hughes, F.S.A, and many other well-known antiquaries. The Schools of Science and Art, which also find a home in the Grosvenor Museum, are a later development, and, under the guidance of Mr. G. R. Griffith, the Honorary Secretary (whose labours, we should state, have been by no means confined to this portion of the scheme, but have tended in a marked degree to the success of the entire undertaking) their operations have been attended with increasing success each succeeding year. The classes held are in connection with the Science and Art Department and City and Guilds of London Institute, and include in their curriculum a wide range of Science, Art and Technological subjects.

Having sketched the nature of the "elements" composing the "Home of Science" in Chester, we may proceed to give a description of the Museum and of its contents.

The exterior of the building is an adaptation of the classic style which was in vogue during the 17th century, the materials for the decorative facing of the exterior being of red brick, with dressings of Grinshill sandstone. The architect was Mr. Thos. M. Lockwood. On entering, a large staircase-hall gives access to each department. On the ground floor are situated the Natural History and Archæological Museums, and a large lecture-hall, in which the various societies hold their meetings. Upstairs, on the first floor, are committee rooms, science class rooms, modelling rooms, and chemical laboratories, whilst the second floor is devoted entirely to the School of Art, the rooms for which are amply lighted. The basement contains store-rooms, photographic dark rooms, &c.

The Natural History Museum is, very wisely, devoted mainly to collections illustrating the *fauna* and *flora*, the geology and mineralogy of the surrounding districts of Cheshire, Shropshire. and North Wales. By restricting the contents to objects of a local character, the collections are rendered far more complete and valuable than if they consisted of merely miscellaneous scraps from all sources. And even within the area prescribed by the Chester Society of Natural Science there is enough material to be gathered to stock a much larger building than the present Museum. Another feature connected with the Museum is that almost the entire series of objects has been gathered together by the industry and labour of members of the Natural Science Society, who thus possess a deep personal interest in the Museum and its progress. This part of the society's work has always been strongly impressed upon the members, and their research has been frequently stimulated by offers of prizes, in the shape of grants from the Kingsley Memorial Fund, of sums up to ten pounds, for collections illustrating the natural science of the Society's district.

The following are the names of winners of the Kingsley Memorial Prizes, recorded in the Museum:—

1878	Helen Smith, E. Okell,	Herbarium.
1879	G. Shrubsole ...	Carboniferous Fossils.
1881	E. Hopkins	Cryptogamic Flora.
1882	G. Shrubsole ...	Mountain Limestone Corals.
1886	R. Newstead ...	Hymenoptera.
1887	J. Lyon Denson ...	Natural History Notes.

In the department of Geology, the collection of local Triassic rocks, arranged by Mr. Aubrey Strahan, F.G.S., is very complete, and includes several fine slabs of Cheirotherian footprints from Storeton. The Carboniferous formation is well represented by some fine corals presented by Mr. Shrubsole, F.G.S., and by plants from the Coal Measures, including a fine *Stigmaria*, from Trefnant, near Ruabon, having bifurcated roots. Mr. Shone's series of shells from the local Drift deposits deserve mention. They are fully described in papers by Mr. W. Shone, F.G.S., in the *Quarterly Journal of the Geological Society*, of London, vols xxx. and xxxiv. In the teaching department a series of fossils and minerals has been presented by Sir Philip Egerton, Bart. Zoology and Botany are both represented by typical collections, amongst which are some cases illustrating the life-history of birds, realistically mounted. Mr. A. O. Walker has contributed several series of Mollusca and Polyzoa, in addition to examples of other natural orders; indeed, there seems

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to be scarcely a part of the Museum which has not been enriched by the labours of this gentleman. Some idea of the interest taken in the development of the Museum may be gathered from the Report of the Curator, Mr. R. Newstead, for 1887-88, an advance copy of which we have been permitted to peruse. This Report gives a list of no fewer than 615 specimens *presented* during the year, which must certainly be regarded as a highly satisfactory state of affairs. If the Museum continues to progress at a similar rate, an extension of the building will soon be a necessity.

We have left until the last, mention of the Archæological Museum, which contains more objects of antiquarian and historic interest than we have space to enumerate. Chester retains many evidences of her ancient glory, and relics handed down from early Roman times are frequently discovered which throw light upon this long-past epoch. Some of the larger inscribed Roman stones, altars, and monuments are placed on a raised platform. Fragments of tiles, tesselated pavements, &c. are also preserved. An illustrated catalogue of Roman altars and other inscribed stones in the Museum has been compiled (with an Introduction) by the Hon. Curator of the Archæological Society, Mr. G. W. Shrubsole, F.G S, and should be consulted by all who wish to learn something regarding these interesting monuments. It would be much to the advantage of students and other visitors to museums if similarly attractive catalogues were more frequently provided by curators for the use of the public. The archæological collection will now be rendered more valuable by the addition of several more relics recently found during some repairs to the north side of the Chester City Walls.

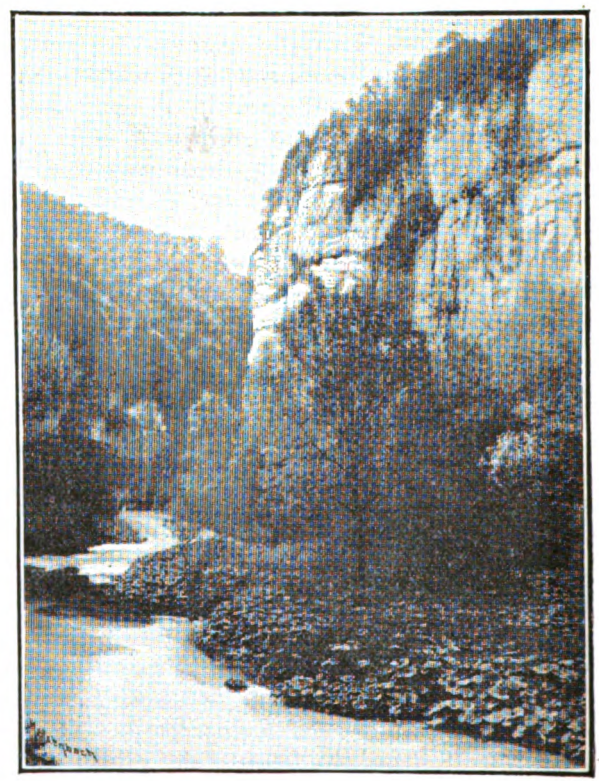
Another use of the Grosvenor Museum is that of an Art Gallery. In addition to a small permanent collection of pictures, an annual Art Exhibition is held. In this way, as has been remarked by Professor McKenny Hughes, "the subjects of art, archæology and science are all linked together. Nobody can draw the line between them." The rising generation in Chester will be enabled to hand down the results of the successful application of this guiding principle.

Scientific Aspects of Health Resorts.

II.—Buxton.

BUXTON, as a popular health resort, is so well known that it is unnecessary to allude here at any length to its general attractions (and these are many), but certainly we should not omit to mention that it possesses a bracing atmosphere and a good and pure water supply; that it affords in its well-laid-out pleasure grounds excellent musical and other entertainments; and that in its immediate neighbourhood there may be found many localities of historical renown, and others, again, of picturesque beauty and scientific interest—in short, no visitor to Buxton need be at a loss for pleasurable employment of time. But what we more particularly wish to point out are the features that can interest the scientific student who may sojourn there for a time. These vary much in character. Those interested in botany will find many rare flowering plants that they may search for in vain in other localities, and the students of cryptogamic botany will find the neighbourhood exceptionally rich in specimens that should interest them, whilst the various conditions consequent upon the many physical characters of hill and dale and moorland afford to students of entomology and other biological inquirers many opportunities for study which naturalists in the surrounding districts have not been slow to avail themselves of. But probably the geological features are the most striking, and here it may be well to call attention to the geology of the district as affecting its scenery. Certainly much time may be profitably spent in noting the many diversities of scenery in relation to the geological formation of the locality.

The greater part of the town of Buxton is situated on the edge of the mountain limestone, whilst a smaller portion is upon the upper limestone shale and millstone grit which crop out here. Numerous quarries in the neighbourhood—such as those near Peak Forest Station, Dove Holes, and on the road to Leek—afford ample opportunity for noting the peculiarities of the limestone formation, whilst in other localities many other problems can be well studied. As regards the mountain limestone, the best section of the limestone rocks may be seen on the Midland Railway between Buxton and Monsal Dale. (This district is referred to in our present number in a report of a meeting of the Liverpool Naturalists' Field Club.) A section of the mountain limestone between these points shows:—1. Thinly-bedded limestone, somewhat earthy, with layers and nodules of chert, and thin shale partings in the lower beds, 250 feet. 2. Thickly-bedded limestone, 50 feet. 3. Thinly-bedded limestone with chert, 90 feet. 4. Toadstone, perhaps in places as much as 100 feet. 5. Massive white



Chee Tor.

limestone, Miller's Dale rock, with perhaps a bed of toadstone in the middle, at least 320 feet. 6. Toadstone, about 20 feet. 7. Very thickly-bedded white limestone, Chee Tor rock, 500 to 600 feet. 8.

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Limestones, more or less concretionary, with shale partings, 150 feet. 9. Limestones, some thickly and some thinly bedded; of these there seen about 100 feet, giving a thickness without reaching the bottom of about 1600 feet. At the east end of Monsal Dale tunnel there is a junction of the Yoredale beds and mountain limestone; and at Dove Holes we find, 1, the limestone with chert, encrinital limestone, limestone with chert, altogether about 190 feet; 2, solid white limestone, 110 feet; 3, toadstone, 4 to 6 feet; 4, massive white limestone, 180 feet; 5, toadstone. This valley between Buxton and Miller's Dale is one of the most picturesque and easily reached of the many possessing interesting geological features in the neighbourhood of Buxton. Seen when travelling through it, either by rail or road, the eye meets with ever changing beauty, whilst the side valleys, which too frequently are passed unnoticed by the ordinary traveller, show equally attractive features that can interest alike the artist or scientific student. Two pictures we give here, from photographs by Mr. J. Kershaw, of Spring Gardens, Buxton, may be taken as illustrating some of the scenery in this neighbourhood, and we have no doubt that they will suggest to scientific students lines of study which we well know are worth following up in this charming valley. But it is not only in this direction that scientific visitors to Buxton can find subjects for study. Not far away on the moorland, near Axe Edge, and in the neighbourhood of the old hostelry, the "Cat and Fiddle," geological students may find much to examine in the special formation and character of the surface and underlying strata in determining the collection of rainfall, and its direction into certain channels. An important tributary of the River Mersey, the Goyt, takes its rise here, and the gathering together of surface water into rills, small streams, and a river course, with other streams entering at intervals and increasing the volume of the main stream, may be seen here to advantage, together with many other examples of water action.

Again, within easy reach of Buxton is Matlock, where the present course of the river may give rise to much conjecture as to why, having due regard to the present configuration of the surface, it should have worked its way into its present channel. Here also we have an example of the deposition of solid matter from water similar to what was referred to in No. 1 of this magazine at the Dropping Well at Knaresborough. At several points alo g the valley at Matlock Bath there are to be seen examples of this "petrifying" action of the water; whilst at other parts may be noticed the deposition of calcareous tufa, which consists of an amorphous carbonate of lime deposited from water as it flows over the surface of the ground. The whole neighbourhood of Matlock gives opportunity for scientific study.

Near Tideswell, and at Barmoor, near Chapel-en-le-Frith, the phenomena of "ebbing and flowing wells" may be noted, but frequently visitors to these wells are much disappointed.

A View in Chee Dale.

One of the most interesting excursions from Buxton is to Castleton, a distance of about twelve miles. In this neighbourhood are three caverns of considerable size and interest, *viz.*, the "Blue John Mine," the "Speedwell Mine," and the "Peak Cavern." In the first-named is found the mineral "Blue John," a fluor spar largely used for ornamental purposes. The colour of this mineral has been said to be due to the presence of manganese, but analyses lately made by the Editor shows manganese to be absent, and he has come to the conclusion that the colour is due to the presence of organic or hydro-carbon matter; and in connection with this view may be mentioned the occurrence of bitumen *(elaterite)* and petroleum in the neighbourhood. The bitumen may be observed in two forms, the first hard, black, and with a shining surface; the second soft and sticking to the fingers, and both varieties may be seen in the "Windy Knoll" Quarry, one and a half miles west of Castleton. It is also found in other parts of Derbyshire, filling cavities in the limestone. In the quarry at "Windy

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Knoll" there is found a good deal of inferior blue fluor spar with bitumen.

In addition to the appearances presented by such caverns, these three afford opportunity for noting some of the phenomena of under-

MAM TOR, SHOWING DISINTEGRATION.

ground streams; and in relation to these it may be well to mention the suggestion of Professor Phillips that the deep valleys, such as Miller's Dale, Chee Tor Dale, Monsal Dale, and Dove Dale, were originally underground channels through which streams ran, and that river and atmospheric action had worn away the roofs until they had fallen in.

Whilst referring to these caverns, it will be well not to omit to mention another, Poole's Cavern, which is within a very easy walk from Buxton.

In the neighbourhood of Castleton, there is also Mam Tor, or the Shivering Mountain, one of the highest mountains of the Peak. In this mountain alternate beds of shales and grits occur, and these, by action of frost and ordinary atmospheric agencies, become much disintegrated and fall down in considerable quantities, as is shown in the above picture, thus giving rise to the term "shivering mountain." There is also not far from here a curious pass, about a mile in length, termed the "Winnats," or Windgates; and, at the head of the beautiful vale of Edale is "Kinder Scout," the highest mountain in the Peak, 2,082 feet above the level of the sea, and of much interest to geologists, botanists, and other scientific students.

But the mineral springs at Buxton have really made its reputation as a health-resort. The chief of these are the Thermal Springs, that supply the baths and pump room. These issue from several fissures in the limestone rocks very near the edge of this formation, at an elevation of 1,000 feet above the sea level, the total outflow being estimated at about 150 gallons per minute; the temperature is given by Dr. J. C. Thresh as being in the autumn of 1882 at 81.5 f. whilst Dr. Playfair found it 82.0 f. in 1852, and both temperature and flow appear to remain remarkably constant.

The water has been analysed at various times by different chemists, including Scudamore and Garden, Dr. Playfair, Dr. Sheridan Muspratt, Mr. Hehner, and Dr. J. C. Thresh, but the analysis of the latter is certainly the most complete.

The several analyses are given, and the question of composition fully described, in Dr. Thresh's book, entitled *Buxton as a Health Resort* (published by C. F. Wardley, Eagle Street, Buxton), and it will be found that with regard to the origin of the waters, the nature and source of gaseous constituents accompanying them, the character of the deposit at the mouth of the springs, and other topics, these waters can afford scope for much interesting inquiry and conjecture. Other thermal springs are to be found at Matlock, Bradwell, Eyam, and elsewhere in Derbyshire.

The foregoing by no means exhaust the subjects of scientific interest that can be dealt with in Buxton and neighbourhood; but the limits of this article will not allow of dealing further with them now. We may, however, inform geological inquirers that one of the best guides is the Memoir of the Geological Survey, by Professor Green, and others, entitled *The Geology of the Carboniferous Limestone, Yoredale Rocks, and Millstone Grit of North Derbyshire*, published by Eyre and Spottiswoode.

The Bugle Coralline.

CELLARIA FISTULOSA LINN.

BY JOSEPH LOMAS, ASSOC. N.S.S.,
Lecturer in Geology, University College, Liverpool.

ONE of the objects of *Research* is to enable those with time and means at their disposal to direct their energies to the accomplishment of useful scientific work, instead of frittering away their talents in an aimless and unproductive manner.

The Bugle Coralline (*Cellaria fistulosa*) presents many interesting problems for investigation, and it is in the hope that someone may be induced to take up the work that a few points are indicated here. The species has always been a favourite with naturalists on account of its great beauty, and the literature on the subject is very great. It rejoices in no less than twenty-four synonyms. In the works of Johnston, Busk, Landsborough, and others, it is called *Salicornaria farciminoides*, but in the later works of Hincks it goes by the name of *Cellaria fistulosa*.

Before describing *Cellaria* in particular, it might be well to consider a few points concerning the group to which it belongs—the Polyzoa. A Polyzoan consists of a colony of individuals, each of which may be compared to a closed bag (ectocyst) filled with a fluid. At one part there is a small thickened ring (lophophore), on which are arranged a series of hollow ciliated processes (tentacles), whose lumen communicates with the cavity of the bag below. In the centre of the ring is an opening (mouth) leading into a tube (alimentary canal), which curves round in a loop, and opens on the surface of the bag again, either inside the area of the ring in some few forms, or outside in most forms. The suspended alimentary canal has no communication with the body cavity, and is kept in its place by bands of muscles, which join it with the body wall. The lophophore is capable of being invaginated, thus carrying with it the tentacles and surrounding parts, just like a glove finger may be turned in by pushing the tip inwards. Thus the polypide is preserved from harm, and it evaginates again when in search of food. The orifice formed by the retracted polypide is further shielded in some forms by a movable valve, called an operculum, and in others by a ring of setæ or hairs, which close the aperture.

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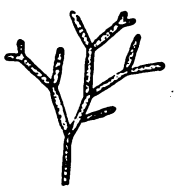
Some species have additional organs for protective and predatory purposes, in the form of avicularia or vibracula : the former are shaped like birds' beaks, and during life continually open and close. They are either sessile or pedunculated, and are usually placed near the orifice. The vibracula are long, slender filaments, which continually sweep backwards and forwards over the orifice. The ectocyst, in nearly all cases, is strengthened either by a coating of chitin or carbonate of lime. In the former case, the polypide can be usually seen through the transparent covering, but when this is calcareous, the parts beneath can only be made out in special preparations.

Most acids, when dissolving the carbonate of lime, injure the softer parts below, causing them to shrink and assume unnatural forms. A thing very much to be desired is some mode of preparation which will remove the calcareous covering, and leave the other parts in their natural state.

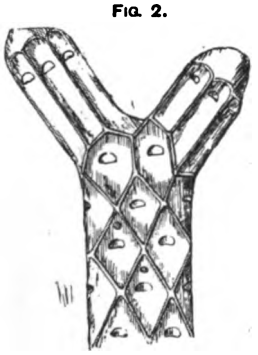
Cellaria fistulosa grows in plant-like tufts, joined to shells or stones by a mass of thin tubular fibres. It is dichotomously branched, the calcereous internodes being joined by chitinous tubes. In the older internodes a lateral branch may originate in the middle, as in *fig.* 1.

FIG. 1.



Cellaria fistulosa, natural size, showing dichotomous branching.

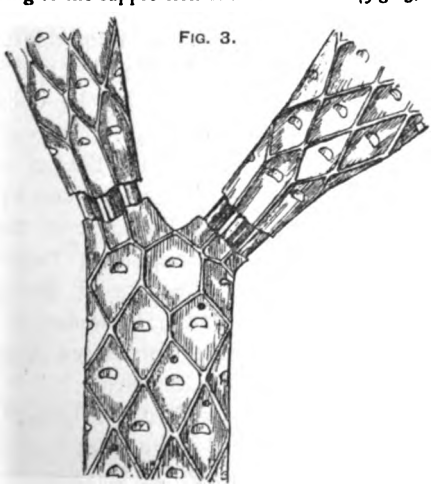
FIG. 2.



Cellaria fistulosa, magnified, showing lozenge shaped cells quincunxially arranged, elongated cells the beginnings of lateral branches.

The cells are arranged radially round a cylinder, and appear lozenge-shaped when looked at in front. They form a regular quincunx. The central portion of the cell is depressed, the contiguous cells being separated by a ridge. About two-thirds up the cell area is the orifice, which is somewhat labiate and transverse, and just above is placed an avicularian (*figs.* 2 and 3). Each branch tapers towards its lower extremity owing to the suppression of a row of cells (*fig.* 3).

FIG. 3.



Cellaria fistulosa, magnified, showing lateral branche more developed, and cells broken, with chitinous tubes inside forming flexible joint

The mode of jointing is very peculiar, and not well understood. When a new branch is beginning to form, the lateral cells are very much elongated (*fig.* 2), but have the apertures as other cells. When the branch has enlarged, these cells break off near the base, and show chitinous tubes inside, thus making the whole flexible. The precise way in which these tubes are formed, their attachments, &c., have never been described, and here is a most interesting field for inquiry.

There are other species of *Cellaria*, one of which, *C. sinuosa*, has characters very similar to *C. fistulosa*. The main differences are said to be in the size of the cylinder, the shape of the cell, and position of apertures, but there is so much variation in one species that some observers doubt whether specific differences really exist.

During a recent dredging expedition, conducted by the Liverpool Marine Biology Committee in the "Hyæna," *C. fistulosa* was dredged near the Calf of Man, with cylinders quite as large as those of *C. sinuosa*, and the cells showed great variety in shape. The examination of a large number of specimens from different localities may settle the question as to whether *C. sinuosa* is a species, or only a variety of *C. fistulosa*.

Cellaria has very close affinities with *Melicerita*, a form common in the crag deposits of the South-East of England. *Melicerita* has its cells arranged in plates instead of in a cylinder, and recently these plates have been proved to be flexible, having nodes along certain lines. The forms have evidently some ancestral relationship, the nature of which opens out a most fascinating question.

Cellaria fistulosa is not difficult to procure. The species is common round our coasts, ranging from shallow to deep water. The trawl nets of the fishermen frequently yield specimens attached to dead shells or loose stones.

For further information, the following works will be found of service :—Hincks' *British Marine Polyzoa;* Busk's *British Museum Catalogue;* Johnston's *British Zoophytes;* Landsborough's *Popular History of British Zoophytes;* Ellis' *Natural History of Corallines;* Waters, in *Quarterly Journal, Geological Society*, vol. xxxvii.

Our Portrait Gallery.

II.—SIR HENRY ENFIELD ROSCOE, D.C.L., LL.D., F.R.S., M.P., &c.

MANY talents combine in SIR HENRY ENFIELD ROSCOE to make him one of our foremost and useful men of science. Not only has he been an earnest student and a good worker in the field of original research, but he has in very many ways aided in making scientific knowledge serviceable to his fellow-men.

Born in London on the 7th of January, 1833, the son of Henry Roscoe, Esq., barrister-at-law, and grandson of the renowned William Roscoe, of Liverpool, he early showed an aptitude for science study, and received a training under men who were themselves earnest workers and able teachers —the late Mr. Balmain (inventor of luminous paint), the late Professor Graham and Professor Williamson, of London, and the great chemist and philosopher, Professor Bunsen, of Heidelberg. He soon made his mark in the world of science, and in 1854 graduated B.A. of London University. Amongst his earlier researches were those very important investigations on the Chemical Action of Light, engaged in with Professor Bunsen, the results of which were published

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in five memoirs in the *Philosophical Transactions* of the Royal Society. In 1857, when not more than twenty-four years of age, he was appointed to the Chair of Chemistry in Owens College, Manchester, a post which he filled up to the year 1886, and in which he proved himself so earnest and able a teacher, and also displayed so much tact and business energy as to aid in very large measure in bringing this College to its present high position as one of the most important educational establishments in the world. The name of ROSCOE will ever remain connected with the great success this institution has attained.

When he first became connected with it, the College only had thirty-four pupils, and the feeling entertained by the Governing Body as to the relative importance of chemistry, and of classics and mathematics, was shewn by the fact that the stipend of the Professor of Chemistry was fixed at one-half of that which was given to the other chairs, but ROSCOE's work has been so thoroughly appreciated that for many years the fine chemical laboratories, built to accommodate 100 workers have been over-crowded, and of the students whom he has trained, very many are now holding positions of great distinction in this country and other parts of the world.

SIR HENRY ROSCOE has always insisted upon thoroughness in study, and especially practical laboratory work. His views regarding the methods of instruction to be employed and the habits to be inculcated in the pupils are well shown in an address on "Original Research as a Means of Education," printed in *Essays and Addresses by Professors and Lecturers of the Owens College, Manchester*, and published in 1874 by Macmillan & Co. Reading this address and noting his remarks on the importance of thoroughness in preliminary study, and the practical training necessary to give dexterity of hand, quickness and keeness of sight, and pliability of mind that should be possessed by all who would undertake original work, it is not difficult to see wherein lay the power that gave his teaching such great success. He truly says:—"As in common life, he who best knows how to meet the many difficulties and to utilise the various opportunities which life presents, is the successful man; so in scientific discovery, he is successful who is able to seize upon and rightly understand the meaning of the phenomena which all eyes witness, but only those of the seer can interpret."

Mainly owing to the great success of the Owens College, and the establishment of other colleges on similar lines, the foundation of a new English University became possible, and in the movement which resulted in the foundation of Victoria University, SIR HENRY ROSCOE took an important part, and greatly aided it with his knowledge and experience of methods of instruction and training.

But SIR HENRY ROSCOE has not only done good work as a College Professor, for he has been very active in other spheres. He has given lectures and addresses in most of the large towns of this kingdom, and has always afforded willing aid in furthering the efforts of others in the cause of education, and the fact of his having given countenance and assistance to such efforts has tended greatly to assist their progress.

His work as a Member of the Royal Commission on Technical Instruction has been invaluable, and it is impossible to read through the reports without seeing how largely his sound knowledge and practical mind have influenced the labours of this Commission. Another way in which SIR HENRY ROSCOE is now aiding educational progress is as Secretary, in conjunction with Mr. A. H. Dyke Acland, M.P., of the National Association for the Promotion of Technical Education, and in this position the value of his experience cannot fail to be felt.

As an author, SIR HENRY ROSCOE is well known, and he writes even on the most abstruse scientific subjects in a clear plain style that can be understood by all. The first edition of his *Elementary Lessons* was published by Messrs. Macmillan & Co. in 1866, and several revised editions in English have since then appeared, and no fewer than 117,000 copies have been sold, whilst it has been translated into many other languages. Of his "Primer of Chemistry" which appeared in 1871, over 160,000 copies have been sold, and translations have appeared in Icelandic, Japanese, Bengalee, Polish. German, and Italian. He is also joint author with Professor Schorlemmer of a "Treatise on Chemistry," which is an important contribution to Chemical literature; and numerous scientific papers, essays, and published lectures show what an active scientific and literary life he has led.

That one so talented and so busy should have received numerous acknowledgments of his work is not surprising, and there might be given a long list of university and other honours conferred on him, and important posts held by him. Amongst these may be mentioned the following: the Honorary Degrees of LL.D. of Cambridge, 1882; of Dublin, 1878; and of Montreal, 1884; M.D. of Heidelberg, 1886; of D.C.L. of Oxford, 1887, when he was also elected Professor Emeritus; President of the Chemical Society of London, 1881; First President of the Society of Chemical Industry, 1881; President of the Literary and Philosophical Society of Manchester, 1882; President of the Chemical Section of the British Association, 1870; President of the British Association, 1887; Governor of Owens College; Governor of Victoria University; Governor of University College, Liverpool; Governor of University College, Dundee; and Governor of Firth College, Sheffield.

In 1884 SIR HENRY received the honour of knighthood, and in 1885 was invited to stand as representative in Parliament, and was returned, as a Liberal, for South Manchester, and re-elected at the election in 1886. In

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SIR HENRY E. ROSCOE, D.C.L., F.R.S., M.P., &c.

From a Photograph by Lombardi & Co., London.

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this new sphere he has already shown how valuable is his scientific knowledge and practical experience in dealing with many matters of vital interest that have to be considered by Parliament, and which it is impossible for ordinary politicians not so trained to grapple with thoroughly. In legislation affecting sanitary matters, manufactures, and education, his opinion must always command respectful attention, and, although his duty in Parliament may remove him to some extent from the more purely scientific sphere, students and men of science well know that they have now in one of the legislative bodies of this kingdom one whom they respect and honour, and whom they can perfectly trust to carefully watch all matters in which they themselves have interest, and take action when necessity arises.

It is impossible in this brief sketch to do full justice to the career of SIR HENRY ROSCOE, but we may safely point to him as an example of thoroughness in study, activity in useful work, earnestness in promoting knowledge and in seeking how best that knowledge can benefit the world in which he lives. A.N.T.

Manchester Technical School.

THE subject of Technical Education is now awakening so wide and deep an interest throughout the length and breadth of the land, and in some towns is being taken up with so much enthusiasm that some account of an institution, which has endeavoured to adapt itself to the need of the time, may be of interest to readers of this journal. Technical Education is by no means a new cry. The Mechanics' Institutions, which, during the last seventy years, have done such good work for education in various ways, did not fail to grasp in their inception the real requirements of our industries, but failed to realise the results they hoped for, because of the imperfect condition of our Elementary Education.

The following resolution, passed at a meeting of gentlemen friendly to the establishment of a Mechanics' Institution in Manchester, held on the 7th April, 1824, may be read with interest as shewing how truly the object of Technical Education was understood sixty years ago, and how long we have been in the effort to give it practical shape :—

"That the instruction of mechanics and artisans in those branches of science and art which are of practical application in the exercise of their various trades, is of the utmost importance, enabling them more thoroughly to understand their business; giving them a greater degree of skill in the practice of it, and leading them to improvement with a greater security of success."

The history of the Manchester Mechanics' Institution has been one long struggle, with very varying and limited success, to realise the foregoing aim. It was not, however, until the beginning of the year 1882, when the financial resources of the Institution were severely straitened and the necessity of a new departure became urgent, that plans were formed to place the Institution on a new basis. On the 28th July of that year, a meeting was held, under the presidency of Mr. Oliver Heywood, at which Sir Philip Magnus announced that the City and Guilds of London Institute were willing to give a donation of £100, and a contribution of £200 for three years (since extended to six years), in support of a suitably equipped Technical School. The proposal to adapt the Mechanics' Institution to the purposes of a Technical School was cordially approved, and on December 27th, 1882, the Manchester Mechanics' Institution passed from the control of its former Directors into the hands of a new Council, composed of representatives of the Corporations and School Boards of Manchester and Salford, the Victoria University, the Owens College, the Manchester Chamber of Commerce, the School of Art, the City and Guilds of London Institute, and, subsequently, the Manchester and Salford Trades' Council, together with gentlemen prominently engaged in the chief staple industries. The classes for the session 1882-83 were already in active work, and the new Council chiefly engaged itself through the spring and summer in making the extensive structural alterations required to carry out their plans, in the preparation of a syllabus, the selection of a suitable teaching staff, and in raising subscriptions.

The school, under the auspices of the new Council, was formally opened on Thursday, September 27th, 1882, for the session 1883-4 by Sir Bernhard Samuelson, the chairman of the Royal Commission on Technical Institutions.

The total amount subscribed was nearly £8000 (being £2000 in donations, and £2000 per annum in subscriptions for three years), of which sum £2248 was required to pay off the indebtedness of the Mechanics' Institution.

A succinct statement as to the aims, equipment, and progress of the school will be of interest to those who are anxious to utilise the numerous Mechanics' Institutions, to be found in the north of England especially, and thus secure their successful development and the realisation of their original purposes. What has been accomplished in Manchester has also been achieved at Huddersfield, and may be realised in other towns where similar conditions exist.

The aim of the Manchester Technical School, as it is now called, is to teach the principles of Science and Art in their application to the chief industries of this district. The School comprises three main divisions :—

I.—*A Manual Training School for Boys*, thirteen years of age and upwards, in which the usual subjects of a thorough Commercial Education, including French or German, Elementary Science, and Drawing, both Mechanical and Artistic, are taught. In addition, the pupils have the advantage of a course of systematic Manual Training in the use of wood-working tools and modelling.

II.—*A School of Art, Science, and Technology*, for day students, to which, after suitable preparation, the boys of the Day School, and youths whose parents desire for them special courses of instruction in Theoretical and Practical Mechanical Engineering, and Chemistry are admitted.

The course of instruction includes most of the subjects of the Science and Art Department's Syllabus, as well as the Theory and Practice of Bleaching, Dyeing and Printing, Weaving and Designing, Builders' Work, Mechanical Engineering, Art and Design.

III.—*An Evening School for Commercial, Artistic, Scientific, and Technological Subjects* (embracing almost every industry of importance in the district), in Theory and Practice, especially adapted to the needs of artisan students, foremen, and managers. It may be mentioned incidentally that most successful classes are held for the theory and practice of Dressmaking and Millinery.

The following statement will give a clear idea of the equipment of the School, and how thoroughly an old building has been utilised for the purposes of Technical teaching :—

The large room in the basement has been fitted up as a Mechanical Engineering Workshop, and is supplied with an 8-horse power gas engine; a 6in. centre screw-cutting lathe; a double-geared gap lathe, 6in. centre, and single-speed lathe, 6in. centre, on one bed; one ditto, 7½in. centre; a 5½in. centre hand-turning lathe; a 6in. by 8in. slotting machine; a planing machine, to plane 3ft. by 2ft.; a drilling machine; a shaping machine of 6in. stroke, made in the School; a grindstone;

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twenty-four vice benches; forge; Whitworth's screwing tackle, gauges, and surface plate; appliances for teaching the elements of moulding, practical plumbing, &c.

On the same floor, there is a Metallurgical Laboratory, with benches for thirty students; nine wind furnaces; one coke muffle furnace; four gas muffle furnaces; and other appliances.

A Weaving Room, fitted with nine plain, dobby, and Jacquard looms, for hand and power; card-cutting machine, &c.

A room for Letterpress and Lithographic Printing, with three letterpress machines, and one lithographic press, and appliances.

In the sub-basement, there is a 7-horse boiler, for supplying steam to the Dyeing Laboratory.

The School contains three other Laboratories, two for Pure Chemistry, having accommodation for sixty students; and one for Dyeing, Bleaching, and Printing, with accommodation for thirty students. The Lecture Hall is fitted up with benches, and is exclusively used for instruction in Mechanical and Geometrical Drawing. On the third floor, there are two well-arranged Lecture Rooms, with rising seats, each affording accommodation for 120 students; and a large room furnished with casts, models, and other appliances for instruction in Artistic Drawing, Modelling and Design. One of the large rooms on the first floor is fitted with a complete system of Cotton Spinning Machinery, given by Messrs. Dobson and Barlow, of Bolton; and on the ground floor, the largest room is fitted up as a Wood-working Shop, with twenty-four benches, fitted with tools for sixty students, upon twenty of which are small hand-turning lathes, driven by power. In addition, the building contains numerous class-rooms of the ordinary type, and the School is supplied with a large collection of models, and appliances, illustrating the courses of instruction in Chemistry, Metallurgy, Physics, Building Construction and Drawing, and in Machine Construction and Design, a large number of which have been made by Schröder, of Darmstadt. The School also contains a considerable Library of Technical and Scientific books, which are freely placed at the service of the students.

The Teaching Staff consists of forty-five teachers, and there are upwards of eighty distinct classes.

The following statement of students in attendance, results of examinations, fees received, and grants earned, will serve to indicate the progress of the School since its adaptation to its present purposes. The figures are given for the year ending July 31st.

	Individual Students.	Tickets Issued.	Fees.	Grants.	Science, Art, and Technological Certificates & Passes.
1884.....	1429 ...	2046	£1259 12 5 ...	£1092 15 0 ...	819
1885..... ...	1995 ...	2783	2010 10 5 ..	1273 5 0 ..	1011
1886.....	2209 ...	3091	2241 11 8 ...	1416 12 0 ...	1323
1887.....	2529 ...	3406	2931 10 4 ...	1355 19 0 ...	1244
1888 (June)	2859 ...	3893	3145 14 4 ...	———	—

During the last three years the School has gained 17 silver and 33 bronze medals, with £147 in money prizes, from the City and Guilds of London Institute, for success in the Technological examinations; and is at the head of all the provincial centres in the number of its successful passes.

The students have also gained from the Science and Art Department, during the same time, eight Whitworth Scholarships, of the total value of £1,100; four Royal Exhibitions, each of the value of £150, with three years' free tuition; three National Scholarships, each of the value of £168, with three years' free tuition; and one Free Studentship for three years, value £110.

Four silver and eight bronze medals have been gained for proficiency in Industrial Design.

The Rumney Scholarship, value £135, with free tuition at Owens College for three years; and a Free Scholarship, value £90, at the Central Institute, London, were also gained by the students.

The success of the School has been the means of awakening considerable interest in the question of Technical Education in Manchester and the surrounding district, and schemes are now on foot for the realisation of a complete system of Manual and Technical Training.

The late Sir Joseph Whitworth, Bart., placed in the hands of his legatees very large funds, which they are using in the promotion of Technical Teaching and Training, and, amongst other proposals, it is intended to found a Whitworth Institute of Art and Industry, in which will be embraced a Technical School. For this purpose the legatees will give a large piece of land, comprising about 5,850 square yards, in a central part of the city, upon which will be erected a Technical School, fully equipped for the purpose of giving instruction in Science and Art as applied to the commercial and industrial pursuits of Manchester.

Geological Rambles.

I.—In Charnwood Forest.

THE north of Leicestershire possesses special features of interest to those inclined for geological study, on account of the number of rock formations exposed, rendering this part of the county a desirable centre for work in the field. Amongst the formations represented in this district are the Boulder Clay, Lias, Trias, Permian, Coal Measures and Millstone Grit, in addition to the pre-carboniferous rocks, of which the main mass of the "Forest" region is composed. Although many celebrated geologists have been at work here (including Jukes, Hull, Harrison, and, more recently, Professors Hill and Bonney), there is still plenty of scope for the intelligent student, who will find problems innumerable of the highest interest to engage his attention. The following geological survey maps should be consulted:—Ashby-de-la-Zouch, 63 N.W., and Leicester, 63 N.E. Charnwood is easily accessible on the Midland line, either from Loughborough on the east, or from Coalville on the west. A local railway has also been lately established across the Forest, which will help the wandering geologist on his way.

It would be well to describe, briefly, the physical features of the district. On approaching the Forest, a gently undulating plateau is presented, being in elevation some 450 feet above the sea; the north-western portion of this area consists of the Ashby-de-la-Zouch coal-field, while to the south-east, above this comparatively level country, rise abruptly the ancient hills of Charnwood Forest, reaching a height of from 300 to 400 feet. The oldest strata appear in these highlands, which present a picturesque ruggedness to the eye,—high masses of barren rock jutting forth from green hill-sides, with their peaks fantastically carved by the ever-active agents of denudation. The Forest (which, it should be remarked, is not now a "Forest" at all, the district being characterised by general absence of trees everywhere, except in a few well-sheltered dales) consists of two lines of hills, formed of slaty and volcanic rocks, separated by a valley filled with Triassic sandstone. An "anticlinal axis" crosses the Forest in a direction from north-west to south-east, from each side of which the rocks dip outward. This is well seen near Benscliff. Regarding the age of these slaty beds there has been much difference of opinion, and different authorities have successively attributed them to the Silurian period, then to the Cambrian, and latterly, through the more modern researches of Messrs. Hill and Bonney, they have been added to the increasing list of pre-Cambrian, or Archæan strata. The lithological characters of the rocks show, it is said, a marked similarity to the "Pebidian" of Dr. Hicks; and it has been pointed out by Professor Judd that many of the altered volcanic ashes and agglomerates resemble the pre-Cambrian lavas of the Wrekin. In the absence of direct stratigraphical evidence bearing upon this point (and there is no evidence to be derived from palæontology,

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the rocks being unfossiliferous), it is impossible to say more than that the presumption is in favour of their pre-Cambrian age. It is not our intention here to enter into the controversy, which occupies a somewhat extensive literature : it will suffice our present purpose to indicate some of the chief localities of interest as a guide to the geological explorer.

The following table gives the order of the strata in Charnwood Forest which are older than the carboniferous formations (according to Hill and Bonney) :—

ROCKS OF CHARNWOOD FOREST.

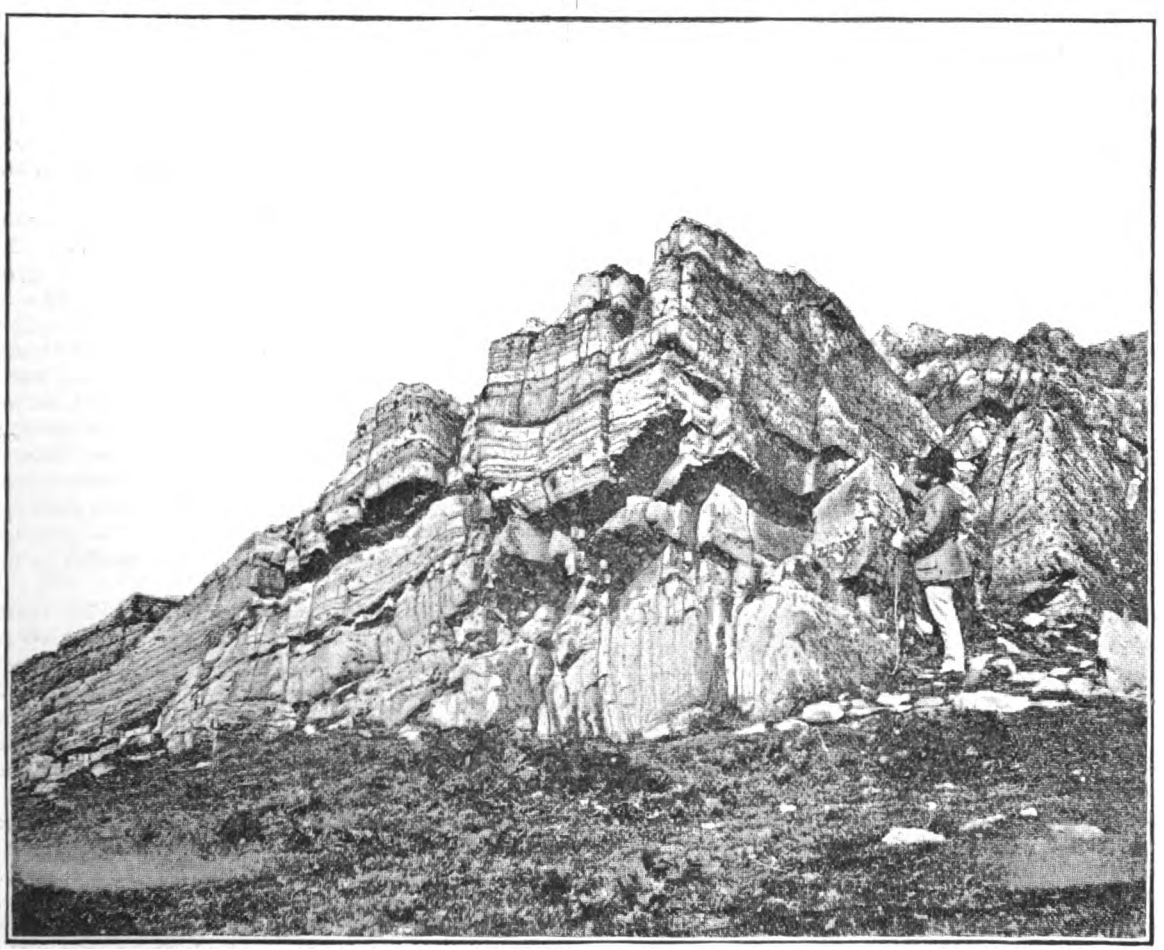
(a) Crystalline and Slaty Rocks.

Series.		Characters.
3.	Swithland and Groby	Fine slates.
2.	Sharpley and Peldar	Felspathic ash.
	Slate Agglomerates	Coarse do.
	Hanging Stones	Ashy slate.
1.	Blackbrook	Fine ash and flinty slate.

(b) Intrusive Rocks.

Hornblendic Granite (Mount Sorrel).
Syenite (Markfield, Cliff Hill, Sapcote, &c.)
Greenstone (Intrusive, in dykes at Mount Sorrel, &c.)

The uppermost rocks are the slates of Swithland. These slates are inferior to those of Wales and Cumberland, having a rougher cleavage. The largest quarry is a deep cutting prettily situated in a wood, abounding with rich trophies for the botanical collector. Keuper Marls are seen resting unconformably upon the slates. The Sharpeley and Peldar series consist of beds of volcanic ash interstratified with the slates. These rocks appear to have been ejected from numerous volcanic cones and accumulated either on land or in small lakes. From Green Hill and Peldar Tor to Sharpeley and the Hanging Stones, dark, bluish slates containing porphyritic crystals of felspar and grains of quartz alternate with beds of altered ash and volcanic agglomerates. The lowest series occurs at Blackbrook, Ives Head, and Moorley Hill, and consists of flinty slate and fine grained ash. The anticlinal line of the forest passes between Ives Head and Moorley Hill. At the latter place, an instructive section is seen in a quarry where the bedding is nearly vertical. Bands of purple, grey, and green colour, known as "Stripe," run through the slates and indicate the original bedding. At Whittle Hill occur the famous "Charley Forest Hones." The slates here are fine grained. From Beacon Hill a good view of the Forest can be obtained, and at the neighbouring "Broombriggs" *(see Illustration)* the coarse, slaty ash is exceedingly well seen.



THE "BROOMBRIGGS," CHARNWOOD FOREST.

(From a Photograph by J. Burton & Sons, Leicester.)

Between Benscliff Wood, Woodhouse Eaves, and Loughborough the scenery is amongst the most charming in the Forest. The traveller who delights in such natural attractions will find here his favourite retreat. Remains of the ancient forest-land which once spread over the entire district alternate with a wilderness of rock and crag.

Nor is the antiquarian interest of the region to be overlooked. On a little outlier of Carboniferous limestone is situated the ancient Abbey of Grace Dieu, founded in 1240, now a picturesque monastic ruin. Further to the south, by the groves of Ulverscroft, whose ruined Priory stands as a

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monumental link between the present and the past, or within the woods of Bradgate, where are preserved still more notable historic memories, the antiquary and the historian, the simple student of Nature, and the scientific explorer will each find a source of enjoyment in their respective callings. The crumbling mediæval stones, ancient though they be, are but of yesterday compared with the far-reaching antiquity revealed by the rocks of Charnwood themselves, whose records, rough-writ, and difficult to decipher, deal with a very early chapter of British geological history.

In our next paper we shall give some attention to the Igneous rocks of Charnwood Forest, which are of great interest, this district being the only part of central England where that useful rock, granite, is to be found. O. W. J.

Photographic Notes.

THE Manchester Amateur Photographic Society publish an excellent little quarterly journal, entitled the *Photographic Record*, which contains the papers read before the society, particulars of excursions, and other information of general photographic interest. The number before us (July, 1888) contains a good paper on "The History of the Lantern Slide," by Mr. J. W. Wade. It will be remembered that this gentleman was the winner of the gold medal at the recent Liverpool Exhibition for his unique illustration of "Bradda Head on the Manx Coast, by Sunset"—an effect which, obtained by purely natural means, has never been excelled as a lantern view. IN the same journal the Rev. H. J. Palmer, M.A., contributes some useful notes on gelatine sensitive films.

THE Chester Society of Natural Science has lately developed a Photographic Section, of which Mr. George Frater is the Secretary. This section has already had several successful meetings, and by explaining and showing the working of the technical side of photography it has been the means of stimulating many scientific students to take an interest in the subject.

AN excursion of this section will take place on the 14th instant, to Mow Cop, near Congleton, and Moreton Old Hall, an ancient, half-timbered mansion surrounded by a moat. This fine old house will afford opportunity for a display of skill by our Chester friends. It should be noted by intending visitors that permission to photograph the Hall may be obtained from the tenant, who makes a nominal charge of 2s. each for the privilege.

A NEW departure has been made in the work of the Belfast Naturalists' Field Club. The importance of scientific photography, as hinted at in our article on "A New Photographic Survey" in last month's number of this journal, has been recognised by the members of this Club, who have filled three large albums with views and pictures taken by themselves illustrating the botany, natural history, scenery, and antiquities of Ireland. The field is practically inexhaustible, and the special scientific knowledge possessed by members of the Club gives them advantages in this pursuit rarely to be found in the professional photographer or the ordinary amateur.

WITH gelatine, starch, and gum solutions always occupying such an important place in photographic technics, the subject of antiseptics naturally will always appeal to the photographer; hence reference may be made to what is perhaps the most recent addition to the list—saccharine. This singular chemical product proves to be of very considerable value in preventing decomposition of many animal matters. It has been proved to arrest decomposition in various animal secretions more completely than either salicylic or benzoic acid, while from its harmless action upon the human economy it is evidently preferable to the efficacious but virulently poisonous corrosive sublimate, and, on account of its freedom from smell, to the strongly odorous carbolic acid.

ACCORDING to the *Naturforscher*, Professor Pflüger and Dr. Tilanus have succeeded in cultivating by Koch's method the bacteria which produce the luminosity of sea fish. They have also been able to place them upon a glass slide, which in the dark appeared thickly strewn with luminous points. Professor van Haren Noman has succeeded in photographing them.

Ornithological Notes.

The Nightjar.

REFERRING to a note on this bird in No. 1 of this journal, the following may be of interest:—

"On Saturday, August 8th, 1886, my children took me to see a nest which they had found by the side of a footpath, near Bidston Hill. On reaching the spot, about twenty yards from a road on which men had been working daily for some weeks, I found that the nest (if it may be so termed) was that of a Nightjar. The parent bird rose from the ground at our approach, and, making a slight circuit in the air, alighted about two yards from where we were standing and a yard from the nest, in which there were two young birds. I had, therefore, an excellent opportunity of examining its plumage, which was particulary bright, clear, and well defined.

The attitude of the bird was one of extreme anger rather than fear, and I was able to observe closely its hawk-like bill, curved at the top, the upper mandible being covered on each side with strong, coarse hairs. It uttered a peculiar hissing or purring sound, varied by a sharp, quick "tchick tchick," which I thought was caused by rapid snapping of the beak.

On examining the spot from which the bird arose I found the young birds, looking somewhat like young partridges, plump and well cared for, and covered with a soft, thick down, light brown, and so much like the ground that, had it not been for the rising of the old bird, they would probably have remained without attracting my attention. Their heads were large and the mouth wide—out of proportion to their bodies. Apparently warned by the old bird, they remained perfectly quiet and still. The spot where they were hatched was on the ground, which was slightly hollowed, bare of vegetation, but surrounded by heather and ferns, and was about a foot in diameter,

The old bird, which had remained fluttering close round us, came nearer and nearer with each flight. We then moved slowly away and it shifted its position about a yard at a time, and flew as if wounded from one bunch of heather to another, keeping up the purring and "tchicking" sounds. We stopped to watch its actions, and finding that we had paused it raised itself about ten feet in the air and then suddenly fell as if shot, and remained on the ground with fluttering outspread wings, which I judged to be about two feet from tip to tip, the wings remaining extended and the tips quivering. One of my children crossed to the place where the bird had fallen, and it then fluttered about a yard, and so continued its action yard by yard until it appeared satisfied that it had enticed us away from its young. Then it mounted into the air swiftly and briskly without any appearance of its former simulated weakness, and, making one circle over our heads, swept away with its swift swallow-like flight.

The position of the young birds was close to a public and much-used footpath, and I trust it succeeded in rearing its young. I first observed the arrival of the Nightjar in the middle of May, and I believe the ordinary time of hatching is the middle of July. I shall be glad of any information on this point, as it appears to me that the 8th of August is unusually late.

From the brightness of the plumage I am inclined to think that it was the male bird that evinced such care and attention, though it is usually the female that shows the greatest anxiety and devotion in averting danger from her young. Only one old bird was visible." R. S.

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Societies.

GEOLOGICAL SOCIETY OF LONDON.—The proceedings at the last meeting of the session, held on June 20th, were of a specially interesting character. No fewer than seven papers were read. Amongst the donations to the library was included a fine copy of that rare work, "*Sylva Sylvarum*," or Natural History, by Sir Francis Bacon, published in 1631. The following were the principal communications read at this meeting :—"On the Occurrence of Marine Fossils in the Coal Measures of Fife," by Jas. W. Kirkby, Esq., communicated by Prof. T. Rupert Jones, F.R.S., F.G.S. This paper gave a useful record of the discovery of marine fossils in the Fifeshire coal-measures, which are of limited extent, the beds dipping beneath the sea towards the east and south. The fossils included many fishes and amphibian remains, besides other characteristic forms of life of this period. The author concluded that the coal-measures were formed in low-lying areas, and that when the land was depressed the waters of the sea had access to such spots, bringing back species of shells and crinoids that had existed in the earlier oceans of the carboniferous limestone. Two papers which followed were eagerly discussed by the members :—"Directions of Ice-flow in the North of Ireland, as Determined by the Observations of the Geological Survey," by J. R. Kilroe. Esq., communicated by Prof. E. Hull, F.R.S., F.G.S., and "Evidence of Ice-Action in Carboniferous Times," by John Spencer, Esq , F.G.S. The direction of glacial striæ in the region referred to has been carefully recorded by Mr. Kilroe; he finds evidences of two sets of striations, the origin of the latter being referred to Scottish glaciation. Striæ, bearing westward, have been observed at a height of 1,100 feet in Co Mayo. Mr. Spencer's paper recited some curious cases of striæ in a member of the Millstone Grit Series, the Haslingden Flag-rock, but it was considered that these markings may have resulted from "slickensides," and that it was hazardous to ascribe them to ice-action. Two other papers were of palæontological interest, as follows :—"The Greensand Bed at the Base of the Thanet Sand," by Miss Margaret I. Gardiner, Bathurst Student, Newnham College, Cambridge, communicated by J. J. H. Teall, Esq., M.A., F.G.S.; "On the Occurrence of *Elephas meridionalis* at Dewlish, Dorset, by the Rev. O. Fisher, M.A., F.G S. Mr. F. Rutley described some remarkable Perlitic Felsites, probably of Archæan age, from the flanks of the Herefordshire Beacon, and made the suggestion from his observations, that felsites, resulting from the devitrification of obsidian, quartz-felsites, aplites, &c., may, by the decomposition of the felspathic constituents, pass, in the first instance, into rocks composed essentially of quartz and kaolin; and that, by subsequent alteration of the kaolin by the action of water charged with bicarbonate of lime and more or less carbonate of iron in solution, these may eventually be converted into epidosites. The last contribution to the proceedings was an admirable and exhaustive paper on "The Ejected Blocks of Monte Somma, Part 1, Stratified Limestones," by H. J. Johnston-Lavis, M.D , F.G.S , the bulk of which was occupied with a detailed description of the microscopic characters of certain limestones and their derivatives which have been ejected at a comparatively late period of the history of this volcano. They are only ejected when the apex of the crater-cavity, formed by an explosive eruption, extends below the platform of the volcano into the underlying rocks. The character of the limestone underlying the platform of Vesuvius may be well studied in the peninsula of Sorrento. They are magnesian in varying proportions, ranging from 1 to 22 per cent.; Silica is usually absent, but rarely exceeds 2 or 3 per cent. The bituminous matter, though a powerful colouring agent, usually exists in quantities too small for estimation, but sometimes reaches 3 per cent. Such are the materials out of which the extraordinary series of silicate-compounds have been developed, and as these materials of themselves could not form peridotes, micas, pyroxenes, &c., it is clear that the silica, alumina, iron, fluorine, &c., must have been introduced from without, viz., from the neighbouring igneous magma. The author then discussed the question of the probable methods, being inclined to favour the notion of vapour in combination with acid gases. The order in which the new minerals seem to develope is the following :—(1) Peridote, Periclase, Humite. (2) Spinel, Mica, Fluorite, Galena, Pyrites, Wollastonite. (3) Garnet, Idocrase, Nepheline, Sodalite, Felspar. The paper was fully illustrated by rock specimens and microscopic sections. The meetings of the Society stand adjourned until Nov. 7th.

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SOCIETY OF CHEMICAL INDUSTRY —The annual general meeting was held at Glasgow on July 4th, in the Bute Hall of the University, under the presidency of Prof. James Dewar, F.R.S. The annual report, read by the General Secretary (Mr. Charles G. Cresswell), stated that there had been a continued increase in the membership of the Society, the total number of members being 2,395, or, with those elected on the morning of the meeting over 2,400. The Treasurer's statement showed that the finances were in a very satisfactory state. The President then delivered an eloquent address, to which we hope to refer at length in our next issue. Afterwards the following officers were elected for the ensuing year :—President, Mr. Ludwig Mond; and Vice-Presidents, Sir I. Lowthian Bell, F.R.S. ; Mr. R. Forbes Carpenter, Professor F. Clowes, D.Sc. ; Sir John Neilson Cuthbertson, Professor James Dewar, F.R.S. ; Dr. John Evans, F.R.S. ; Messrs. David Howard, Ivan Levinstein, E. K. Muspratt, Sir H. E. Roscoe, M.P., F.R S. ; Professor W. A. Tilden, F.R.S. ; and Mr. John Williams. Mr. Mond then took the chair, and thanked the meeting for the honour they had done him. Mr. Thomas Tyrer, on behalf of the London branch, invited the Society to hold its meeting next year in that city. The invitation was cordially accepted. The members, on the invitation of the Executive Council, then visited the International Exhibition. The eighth annual dinner of the Society took place in the evening in the Grand Hotel, Charing Cross. Professor Dewar occupied the chair. On the following day there were excursions to several important engineering, shipbuilding, and other establishments, including a visit to the Ardeer Factory of Nobel's Explosives Company, Limited; and on Friday, there was a cruise on the Firth of Clyde, in the steamer Victoria. The meeting was throughout of a very interesting and successful character.

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YORKSHIRE NATURALISTS' UNION.—The 74th meeting of this Union met at Scarborough on the 16th July. Three routes were arranged on the programme, devoted to (*a*) geological, (*b*) zoological and botanical, and (*c*) marine zoological work. The President (Mr. W. H. Huddleston, M.A., F.R.S.) was to have led the geologists to Robin Hood's Bay, but on account of the unfavourable state of the weather this intention had to be abandoned, and the party were obliged to content themselves with a visit to Crag Hall Quarry. This quarry is simply a great excavation left by the alum workers of former days, when the shales of this coast were of greater commercial value than they are at present. The section exposed at Crag Hall is a very instructive one : the lower estuarine shales and sandstones rest upon the "dogger series," and these again rest upon the alum shales of the Upper Lias. The "striatulus" beds, or passage beds between the oolite and the lias, are here wanting, and it is noticeable that the "dogger," which at the other side of the fault attains a thickness of 100 feet, is here attenuated and does not exceed a thickness of four feet. This immense difference is an important geological problem and needs further consideration. In vertebrate zoology little out of the ordinary line was observed, the specimens seen embracing mainly the jackdaw, yellow bunting, and the white-throat. The botanists were more fortunate, as the district possesses a pretty fair variety of plants. Among those named at the sectional meeting were the bee orchis, carex vulpina, agrimony, some of the scrophulaceæ, spurge laurel, myrrhis odorata, about a dozen meadow

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grasses, the larger equisetum, ferns—the hart's tongue and the aculeata, and the male fern with very deeply cut pinnæ On arrival at Scarborough the collections in the Museum of the Scarborough Philosophical Society were thrown open for the inspection of the members. The general meeting was held under the chairmanship of the President later in the day. We would take this opportunity to draw attention to the excellent results obtained by the Yorkshire Union of Naturalists' Societies in the furtherance of systematic research in a more thorough manner than can usually be effected by a single society or association. The system so successful in Yorkshire could well be adopted in some other counties

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LEEDS NATURALISTS' CLUB.—In the Leeds district we again notice a gratifying amount of practical work accomplished by several local societies. The useful organisation whose name stands at the head of this notice have, during the past month, held field meetings at Selby and Collingham. At the former the forest of "Bishop Wood" was made the special scene of the Society's labours for the day. Amongst the plants collected were the following:—Lamb's lettuce (*Valerianella olitoria*), pepper saxifrage (*Silaus pratensis*), common water dropwort (*Œnanthe fistulosa*), yellow water iris or corn-flag (*Iris pseudacorus*), mare's tail (*Hippuris vulgaris*), curly pond-weed (*Potamogeton crispus*), opposite-leaved pond-weed (*P. densus*), amphibious yellow cress (*Nasturtium amphibium*), common wormwood (*Artemisia absinthium*), field crow foot (*Ranunculus arvensis*), and others. The lepidopterists obtained specimens of the following butterflies and moths:—*Vanessa atalanta, Lycæna alexis, Satyrus janira, Pygæra bucephala, Hibernia progemmaria, H. defoliara. H. pilusaria, Larentia albicillata, L. montarata, L. bilineata, and larvæ of Liparis auriflua, Dicranura vinula.*

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LEEDS Y. M. C. A. CLUB.—On 5th July a paper was read by Mr. A. Poppel on "Botanical Rambles round Leeds," giving a brief account of visits to Adel, Meanwood, and Cookridge. At the following meeting, on 12th July, Mr. F. J. Dawson submitted a report of the entomological work of the past year.

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MANCHESTER SCIENTIFIC STUDENTS' ASSOCIATION. — Good work has been done during the month by this Association. At a Saturday afternoon excursion to Glossop some interesting botanical observations were made. The district known as Mossy Lea was visited, but only few plants in flower were obtained. The zoologists of the party discussed the habits of the Common Weasel (*mustella vulgaris*), the Polecat (*M. putorius*), and the Stoat (*M. erminea*). These out-of-door studies are productive of sound results in the direction of acquiring a practical knowledge of natural history.

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MANCHESTER AND DISTRICT SCIENCE AND ART TEACHERS' ASSOCIATION.—A meeting of the members of this Association was held at the Technical School, Princess Street, Mr. John Angell, F.C.S., presiding. Sir Henry E. Roscoe, F.R.S., was re-elected president of the Association for the ensuing year, and Mr. G. H. Hurst, F.C.S., was elected honorary secretary. Mr. J. H. Reynolds, secretary of the Manchester and District Association for the Promotion of Technical Education, delivered an address on the recent changes in the Science and Art Department's Directory, and the Technical Instruction Bills now before Parliament. He pointed out the disastrous effects which would most probably be produced in relation to the teaching of drawing, and on science teaching generally, especially in country districts, smaller institutions, and detached classes such as abound in villages and in smaller towns, if the proposed new arrangements were carried out. Several members present agreed with Mr. Reynold's views, and said that a number of classes in outside districts had already been closed in consequence of recent changes made by the Science and Art Department.

LIVERPOOL MARINE BIOLOGICAL COMMITTEE.—During the past month the work of this Committee has been actively pursued. Three of the members visited the Biological Station at Puffin Island for a few days, and were busily engaged in shore work and tow-netting, and succeeded in obtaining some rare Copepoda, Amphipoda, and Ascidians. One of the Chester naturalists has also been there working at Algæ; and Professor Herdman, with Professor Miall, of Leeds, and Mr. Hurst, of Owens College, and others have been engaged in dredging operations.

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LIVERPOOL ASTRONOMICAL SOCIETY.—The seventh annual meeting of the above society was held on July 9th, at its rooms at the Royal Institution, Colquitt Street, J. E. Gore, Esq., F.R.A.S., in the chair. In the annual report the Council expressed great satisfaction at the decided progress the society had made, both in its financial condition and in the scientific work accomplished. "The financial state of the society," says the report, "continues satisfactory, and it is gratifying to notice that it has now proved self supporting." The reports and observations which have been sent in from the various Sections are of much importance. In the *Solar Section*, Messrs. Radmore and Brown, in the *Lunar Section*, Mr. T. G. Elger, in the *Planetary Section*, Messrs. Elger, Brenan, Smart and Kempthorne, in the *Variable Star*, *Double Star*, *Cometary* and *Meteoric Sections*, Messrs. Tarrant, Maw, Denning, Booth, and the Rev. W. R. Waugh have all done excellent service. In the *Educational Section* the services of Mr. James Gill have been at the disposal of a large number of members. A new branch of the society has been formed in Douglas, Isle of Man, which already includes 27 members, and promises to rapidly increase. The society has it under consideration to establish periodical examinations in astronomy, and, with the co-operation of the Universities, to grant certificates of competency. The report concludes with a special commendation from the Council on the services to the society of Mr. W. H. Davies, the retiring secretary. "With a deep regard for the society's welfare he has cheerfully borne the heavy labours of the secretaryship, and has shown a singleness of purpose and a disinterestedness which entitle him to our warm gratitude." After the reading of the report and balance sheet, the ballot for the Officers and Council for the ensuing session took place, and the following were elected:—*President*—Mr. T. G. Elger, F.R.A.S. *Vice-Presidents*—Messrs. W. F. Denning, F.R.A.S., J. Gill, F.R.A.S., J. Hartnup, F.R.A.S., and Herbert Sadler, F.R.A.S. *Editor and Librarian*—Mr. J. H. Isaacs. *Secretary*—Mr. W. E. Rowlands. *Treasurer*—Mr. W. H. Davies F.R.A.S. *Council*—Mr T. W. Backhouse, F.R.A S, Miss E. Brown, Messrs. T. W. Clarke, J. L. Coxon, W. H. Davies, Jun., J. E. Gore, F.R.A.S., M.R.I.A., George Higgs, Major E. E. Markwick, F.R.A.S., Messrs. W. H. S. Monk, M.A., F.R.A.S., Walter Sang, K. J. Tarrant, and Major H. Watson, F.R.A.S. A short conversational discussion took place, during the scrutiny of the ballot, on Mr. Lockyer's meteoric theory of comets. On the motion of Mr. Herbert Sadler, and seconded and supported by Messrs. Isaacs, Rowlands, and Clarke, a special votes of thanks was unanimously and warmly accorded to Mr. W. H. Davies for his services to the society since its foundation. The usual vote of thanks concluded the meeting.

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LIVERPOOL NATURALISTS' FIELD CLUB.—The fifth field meeting of this year was held on July 12th, at Miller's Dale and Buxton. By the kindness of Mr. Bagshawe, of Sheffield, the party was allowed to proceed through the picturesque grounds by the River Wye, beneath the famous Chee Tor. Not very much botanical work was done, for, though plants were in abundance, there was not a very great variety. Most of the party, after leaving Mr. Bagshawe's grounds, proceeded to Buxton through Chee Dale in a waggonette, while others walked there by way of the Lovers' Leap. The order prize was taken by Mrs. E. Davies, with eight species of leguminosæ. Miss M. E. Clementson was

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awarded the prize for the three rare plants, viz., *ribes nigrum* (the wild currant), *geranium sanguineum*, and *asplenium trichomanes;* Miss Lomax took the prize for the best basket of flowers; and the botanical enigma (*geum rivale*—the water aveus) was solved by Mrs. Davies, Miss Clementson, Miss Hunter, Mrs. Martin, and Dr. Ellis. The entomologists noticed enormous quantities of the somewhat local *Abraxas ulmata* (the clouded magpie moth), a very near relative of the common *A. grossulariata*, so destructive in its larvæ stage to currants and gooseberries. A small geological party, led by Dr. Chas. Ricketts, F.G.S., instead of alighting at Miller's Dale proceeded to Monsal Dale station. In the neighbourhood of the station a mineral vein, worked mainly for barytes, was visited and some specimens obtained, while the continuation of the vein on the opposite side of the valley was pointed out. Dr. Ricketts drew attention to the abundance of chert in the upper limestone beds of this district, and afterwards contrasted the absence of this substance in the lower beds of the series. Proceeding along Monsal Dale a large accumulation of what was apparently "screes," due to the weathering of the limestone cliffs, and cemented by carbonate of lime, was passed, and close to Cressbrook Mills an exposure of toadstone was met with, intercalated between massive beds of limestone. The toadstone was amygdaloidal, the vesicles being filled with calcite, and Dr. Ricketts has found under similar conditions at Bakewell crystals of quartz in the midst of these kernels of calcite. Between the toadstone and underlying limestone were other lava flows interstratified with beds of volcanic ash. In Tideswell Dale the toadstone was again seen, resting this time on a thin bed of red clay, which at the junction with the toadstone was much altered and had assumed the form of very well defined prismatic columns, some of which were seen several inches long. The gorge-like character of the valleys was pointed out, and the manner in which the limestone broke up by means of joints, so as to form vertical cliff-faces, well exemplified in Rancher Tor. Several instances of enormous masses of limestone detached by joints, and apparently ready to fall, or which had recently fallen, were observed. In Miller's Dale the junction between the toadstone and the overlying limestone is well seen for a considerable distance by the roadside, and under Rancher Tor the green colour of the amygdaloidal enclosures in the toadstone gives it a distinctive and beautiful appearance.

LIVERPOOL SCIENCE STUDENTS' ASSOCIATION.—The fourth field meeting of this Association was held at Ince-Blundell on Saturday, 14th July. On arriving at Hightown station by train from Liverpool, a visit was paid to the neighbouring sandhills, where several interesting plants in flower were obtained. The peat-beds situate at the mouth of the river Alt attracted some considerable attention. The origin of these submerged forests and beds has been a source of controversy amongst geologists, it been argued by some that the trees and plants which enter into the composition of these interesting deposits have grown *in situ*. Others maintain that the vegetable matters have been drifted to their present position by the action of floods and inundations, such as would be likely to cause rivers to overflow their banks. As far as the peat-beds in the neighbourhood of Liverpool are concerned, the former theory is the most probable. These peat-beds are the equivalents of the sub-marine forest beds at Leasowe, on the opposite side of the Mersey, where in the upper bed may be seen the trunks of trees in the perpendicular position in which they grew, with the roots ramifying in the soil beneath. The remains of various animals of both ancient and recent date have been found from time to time. Amongst these may be mentioned *Cervus Elephus*, *Bos taurus*, *Bos longifrons*, *Equus* and *Ursus*. Leaving Hightown the members made their way by field-paths and roads to the village of Ince-Blundell. The numerous ditches by the wayside afforded ample scope for the students of pond-life, and the botanical members collected upwards of 120 plants in flower. Among the more interesting plants found were *Blyssmus compressus*, the ciliated variety of *Saponaria officinalis*, *Orchis incarnata*, *Iris pseudacorus*, *Myosotis palustris*, *Lychnis githago*, and the pretty water plant, *Hottonia palustris*. The order prize, awarded for the best collection of plants in flower belonging to the orders *Leguminosæ* and *Gentianaceæ*, was obtained by Mr. D. Price, with 11 specimens; and Miss Mary Stuart gained a prize for the largest number of leaves botanically described. In the course of the meeting the Hon. Secretary (Mr. J. Brack Warriner) nominated three candidates for membership. Before returning to Liverpool a visit was paid to Ince Blundell Hall. The entrance hall, containing many fine specimens of sculpture, including several masterpieces, and the picture gallery and the dining hall, with its beautiful examples of panelled tapestry work, were inspected, and evoked much admiration.

LIVERPOOL GEOLOGICAL ASSOCIATION.—The ordinary meeting was held on Monday, July 2, 1888, Mr. A. Norman Tate, F.I.C., &c., President, in the chair. The Hon. Secretary (Mr. D. Clague) read a paper on the "Flexures, Faults, and Slickensides of the New Red Sandstone," in which, after describing a number of the most remarkable of the flexures and contortions so abundant in the trias rocks of the neighbourhood, and referring to the numerous well known faults in these rocks, he proceeded to discuss the possible causes of these features, and came to the conclusion that most of them had been caused by earth movements in the Triassic Age, due to the slow and gradual upheaval of the anticlines of the Pennine Chain, Ireland, Isle of Man, and North Wales, and the consequent depression of the regions forming the synclines between them, in which the new red sandstones were laid down whilst those earth movements were in progress. Considerable interest was excited by the enunciation of this conclusion, and a keen discussion followed the reading of the paper. The outdoor work of the Association for July comprised excursions to Wallasey (Monday, 9th), and Thurstaston (Saturday, 14th). Following so closely on the Secretary's paper on the "Flexures, Faults, and Slickensides of the New Red Sandstone," certain features bearing on this subject, and well illustrated at each locality, naturally came in for a large share of attention. The intricate current-bedding seen in Breck Road, Wallasey, on approaching from Egremont, was closely studied as being a characteristic feature of the Trias, while the contortions found at the roadside a little further north were scanned in all their details with a view to comparison with those shown in Thor's Stone at Thurstaston. Those minor movements in the earth's crust which sometimes affect the strata without producing any visible displacement were seen to have operated at both places in producing nearly horizontal sets of parallel striæ (slickensides) on the opposed faces of massive joints. The escarpment of Keuper sandstone at Thurstaston, it was observed, trended pretty accurately in a direction at right angles to that of the main system of joints, so that one end of the shelf was higher than the other. The tabular masses into which the rock, both in front of and behind the great escarpment is divided, are not uncommon features in sandstones having a massive and regular jointing, though not found so finely developed elsewhere in the neighbourhood of Liverpool. Thor's Stone, the most abruptly angular of these minor bluffs, afforded a fine study in this direction.

Reviews.

On "Linear Expression," by Wm. Main, M.D. [Privately printed, 1887.]

A QUESTION which will interest others besides students of Darwin is discussed in a little *brochure* under the above title, by Dr. W. Main, of New Ferry, who has made an extensive series of observations on the direction and character of lines in influencing expression in man and animals, and even in plants. In a work which has become a classic, Darwin many years ago treated of the "Expression of the Emotions," but his hypothesis, embodied in the doctrine of "antithesis," is not an entirely satisfactory explanation of the phenomena observed by Dr. Main. The author of the new pamphlet,

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observing some years ago a statement in the *Art Journal* that "up-tending lines were indications of power and progress, down-tending lines, on the contrary, suggested sadness and decay, while horizontal lines were indicative of peace and repose," was led to institute a series of observations, applying this law of art to all kinds of objects. The stiff, straight points of the pine amongst trees give an expression of energy, a suggested feeling which becomes modified as the tree advances in age. Down-lines in vegetable life, instanced by the willow, elm and ash, are frequently suggestive of sadness and decay. In the case of animals the feeling is more marked, as may readily be seen in the dog, in whose attitude and expression up—or down—lines become prominent as the animal exhibits the energy of attack or the depression of sickness. The same law is found to apply in great measure to human beings, and different expressions indicated by well-marked lines in the face and form are cleverly analysed. The author explains that in the case of plants, mode of cellular growth, and in animals, tension or relaxation of the muscles, will probably account for the curious law which forms a very interesting physiological study.

Proceedings of the Liverpool Naturalists' Field Club, 1887.

From the report which appears at the head of this year's volume of "Proceedings," it is evident that this old-established club retains a healthy state of vigour. There have been held during the summer ten field meetings, having an average attendance of forty-five. The following is a list of places visited:- Shotwick, Erbistock and Wrexham, Upholland, Moel Fammau, Hooton, Lydiate, Giggleswick and Settle, Willaston and Neston, Formby, and Chester. The prizes for botanical work have been well competed for. The usual President's Address is not printed this year. Its subject was "The Radiolaria Collected in the 'Challenger,'" but, owing to difficulties connected with the illustrations, a Lecture by the President on "The Ministry of Colours in Nature" (originally delivered by him at the Art Club) has been substituted. Mr. Higgins' lecture is excellent, and, like all emanations from his pen, breathes with the appreciation of the wonderful beauty of Nature as it exists around us, which is so characteristic of the author. Amongst the other contents of this volume may be mentioned an appendix of localities to the "Flora of Liverpool," by Mr. Robert Brown, the usual full descriptive details of the excursions, the annual botanical *resumé*, and lists of some of the most interesting plants noticed during the year's excursions. A somewhat high-coloured frontispiece illustrates the Spring Bok *(Gazella Euchore)* from South Africa. We are glad to observe that, under the energetic Secretaryship of Dr. J. W. Ellis, F.L.S., the Field Club is once more giving evidence of admirable work.

The Scottish Naturalist, a Quarterly Magazine of Natural Science.

The July number of this magazine, edited by Professor James W. H. Trail, A.M., M.D., F.L.S., contains several contributions of importance to students of natural science. Mr. Nical Simpson gives the first instalment of the "Ornithology of Arbroath," being a list of one hundred and four birds observed within a radius of about seven miles from that town. After the name of each bird is appended an interesting note, and Mr. Simpson acknowledges his indebtedness to Col. H. M. Drummond Hay, the eminent ornithologist, for guidance and encouragement in his studies and observations. Professor Trail, the Editor, contributes another instalment on the gall making diptera of Scotland. This part occupies about twenty pages, and is a portion of a paper read before the East of Scotland Union of Naturalist Societies in June, 1887. Although the descriptions are necessarily brief they are yet sufficiently full and clear to enable a beginner to recognise the galls from them. For the benefit of those who wish to commence the study of our native galls the Editor gives a list of those continental publications most useful for the study of the dipterous gall-makers. Another contribution by the Editor is a complete list of the lepidoptera of the Outer Hebrides, Orkney and Shetland. This list was prepared from two lists by Mr. South, which appeared in the numbers of the *Entomologist* for February and April of this year. The other communications are "Contributions Towards a Flora of Caithness," by J. F. Grand and Arthur Bennett, F.L.S., and a short description of some lichens found on the shores of Loch Rannoch in September, 1882, by Dr. J. Stirton, F.L.S. This quarterly contains a full store of compressed and concentrated scientific information, and its primary value perhaps consists in the fact that the articles which adorn its pages are the outcome of minute observation and are trustworthy. W. D. H. D.

Correspondence.

THE WEATHER IN LANCASHIRE.

TO THE EDITOR OF "RESEARCH."

Sir,—I beg to forward the following statistics, taken from our register of the meteorology for the first and second weeks in July, 1887 and 1888. The differences are expressed by the signs, + = increase, and — = decrease, of the last 14 days compared with corresponding days of 1887. The contrast is so remarkable as to merit note.—I am, yours truly, W. W. Midgley, F.R. Met. Soc.

Bolton Observatory, 15th July, 1888.

Instruments.	Week ending July 7th	Week ending July 14th
Barometer corrected	— ·427″	+ 0 170″
Temperature at 9 a.m.	— 11·6°	— 11 6°
Max. in the shade	— 11·2°	— 11·4°
Min. do.	— 2·6°	— 9·3°
Solar heat	— 14·6°	— 12·6°
Solar radiation, max	— 26·3°	— 19 4°
Terrestrial radiation, min	— 4·7°	— 16·1°
Soil at 1 foot deep	— 7·2°	— 7·2°
Soil at 2 feet deep	— 5·5°	— 6·3°
Anemometer (in miles)	+ 72ms.	— 63ms.
Rainfall (in inches)	+ 3·007″	+ 1·062″
Sunshine (in h. and mins.)	- 43·44″	— 8·36″
Mean temp. (corrected)	- - 8·8°	—11 89°
Ozone (0 to 10)	— 3 0	+ 0·2
Humidity (satura. = 100)	+ 17p c.	+ 10p.c.
Elastic force of aq vapour	— ·072″	— ·017″
Degs. above growing point	— 70·7°	— 79·8°

Professor Carvill Lewis.—We much regret to notice the death, at Manchester, of Professor Henry Carvill Lewis, Professor of Geology, Philadelphia, United States. Professor Lewis, although only 34 years of age, had risen to eminence as a geologist. He was interred in the graveyard of Walmsley Church, near Bolton, in the presence of many sympathising friends, Mr. Mark Stirrup attending as the representative of the Manchester Geographical Society.

Donations to Free Libraries.—In a valuable paper read at a recent meeting of the Mersey District Librarians' Association by Mr. Thos. Formby, of the Liverpool Free Library, some practical suggestions were offered by the author for obtaining increased donations in the form of money, books, buildings, &c., so much required, owing to the inadequacy of the penny rate for the maintenance of free libraries. These suggestions may be made as applicable to museums as to libraries, many of the donations received by these and similar institutions being selected with a view less to the proper development of the museum or library in needed directions than to the gratification of the donors. It would appear that the American libraries receive annually much larger donations of books and other necessaries than those in England, the money value of such gifts made during the past year to certain typical free libraries in America being estimated at £330,000, whilst the value of the gifts to similar institutions in England would not exceed £47,000. Of course we have in our own country many instances of private munificence in regard to free libraries (a notable instance of local interest occurring in the Village Free Library established at Bebington, Cheshire, by the late Joseph Mayer, F.S.A.); but to a great extent our own free libraries have to depend upon what little resources the local rates allow for their needs. It is satisfactory to find that Government memoirs and other official publications are now being distributed amongst the public libraries in a more generous manner than has formerly been adopted. The persevering efforts of Mr. Yates, of Leeds, have in some measure aided this result, though in this respect the liberality of foreign governments in disseminating official information quite puts in the shade anything yet attempted by the authorities in the United Kingdom.

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Research:

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NOTICES.

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Remittances for Subscriptions should be made payable to E. O. WINDEL, care of C. Birchall, 32, Castle Street, Liverpool.

Remittances and Communications respecting Advertisements, should be addressed to C. BIRCHALL, 32, Castle Street, Liverpool.

Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Notes and Comments.

COMMERCIAL MUSEUMS.—Reference is made in one of our "Museum Notes" to the new Commercial Museum at Antwerp. The importance of such museums in stimulating scientific inquiry respecting natural and manufactured products, and in aiding commerce and industries, is not sufficiently appreciated in this country. In many directions on the Continent and in America the authorities and inhabitants are fully alive to the value of such collections. And there cannot be any doubt amongst those who have examined them that well-arranged collections of natural products, with descriptions by carefully-arranged handbooks, and lectures on the properties of the several specimens, the purposes to which they may be applied and the processes by which they may be made serviceable cannot be only of value in scientific research, but can assist greatly in the further development of industries and commerce. It is noteworthy, as illustrating the apathy of this country in this direction, that the report of the British Consul at Antwerp respecting the new museum at Antwerp states that, though many other countries have assisted with valuable contributions, very few exhibits have been sent from Great Britain and India.

LABORATORIES OF RESEARCH, specially arranged for the examination of raw products and manufactured substances would prove fitting adjuncts to Commercial Museums. In them new imports might be subjected to tests to ascertain the purposes for which they are best suited; and substances already known, but not used, might be systematically examined to endeavour to find uses for them. A large number of new substances are brought into the different ports of this and other countries each year that, properly used, could be made of much commercial value, but now, for want of more careful examination than is given them, remain for a short time noticed only as curiosities and are then forgotten. Such laboratories might also be made available for finding new uses for substances already employed, and thus probably assist in finding outlets for commodities with which the market is overstocked. In these and other ways work carried out in such laboratories of research by specially trained operators could be made of the utmost value to our commercrce and industries. It is true that much of this kind of work is now carried on in private laboratories, and in the laboratories of manufactories, but in specially organised

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institutions the work done might have more direct influence upon the trade and occupations of the localities.

MICROSCOPICAL LABORATORIES.—Microscopy is making such rapid strides that it is highly desirable that more facilities should be afforded, than at present, for training in this important branch of science. In this country instruction in the use of the microscope is given more as an adjunct to the teaching of other subjects, whereas it well deserves attention as a special study. A laboratory lately fitted up at the St. Louis College of Pharmacy may be taken as a type of what can be made really valuable for promoting microscopical research. This laboratory is in charge of Professor W. H. Whelpley, and is fully equipped with microscopes, microtomes, microscopical accessories and mounting materials, so that all the various methods of preparing and mounting substances can be properly taught. The first course of instruction embraces the following subjects:—review of the principles of optics as applied to microscopical technology; structure and use of the microscope and accessories; use of mounting appliances, materials, solutions, re-agents, &c.; preparation of sections, grinding, cutting, bleaching, staining, &c.; making the various styles of dry transparent and opaque mounts; mounting in balsam and in glycerine jelly, and special media; mounting in fluids; drawing and measuring objects; determining magnifying power of simple and compound microscopes, &c. An advanced course is given for the benefit of those who desire special instruction and practice in vegetable histology, microscopical detection of adulterations, microscopy of the pharmacopœia, &c. In connection with the instruction given there is a Club composed of persons who have taken the microscopical laboratory instruction, and the students of each class are invited to attend the monthly meetings of the organisation. Such laboratories and courses of instruction cannot fail not only to promote a thorough study of microscopy, but must greatly forward other branches of study in which the microscope is employed.

SCIENCE AND ART EXAMINATIONS.—MECHANICAL SUBJECTS.—We publish this month in our correspondence columns a letter from an experienced teacher criticising the examinations in mechanical subjects. Referring to the papers in Applied Mechanics, he complains that they are not of a sufficiently practical character, and that, if taken as a guide for the teaching required, lead to the waste of much valuable time. Now, there can be no doubt that for some years past every effort has been made by the Science and Art Department to make their examinations a really good practical test of knowledge. "Cram" has been assiduously discouraged, and in most of the subjects the questions are incomparably superior to those of many other examining bodies; and although there are not unfrequently examples of failures and successes that surprise teachers and others who know the capabilities of the students, the examinations must be considered on the whole fairly satisfactory. But with regard to some few subjects there are no doubt many complaints. With regard to Applied Mechanics, and other mechanical subjects, very many of the teachers are thoroughly practical men, who endeavour to make the teaching of these subjects of good practical service to their pupils, and they naturally do not want to waste time or tire out their students in teaching that which has not an important bearing upon the subjects they teach, and is of little or no practical use when taught. A very large amount of money is now spent on this department for "payment on results," but the outcome of the teaching must not only be the success of the pupil at an examination, but power given to him of employing the knowledge gained in useful directions. And holding these views we think the remarks of our correspondent are worth very careful attention, and we invite further correspondence on this subject.

BOTANY EXAMINATIONS.—We also publish a letter on this subject, and we know that for some reason or other disappointments and complaints are frequent. The cause does not appear to be so much in the nature of the questions put as in some other detail of the examinations. We think it might be well to inquire whether the practical part of the examination is what it should be. For example, are the specimens sent always received in a sufficiently undamaged condition to allow of their being properly examined by the pupils? And, next, whether in some of the examination rooms there are sufficient facilities, such as good light, &c., for examining plant specimens? These and other points require attention, and we trust that the inquiry of "Umbel" will lead to discussion and further information concerning these examinations in botany.

Local Museums.

III.—Bath.

IN connection with the visit of the British Association this month to Bath, our readers will doubtless be interested in the valuable Museum formed by the Royal Literary and Scientific Institution of that historic city. Originally this Institution had its home in the Old Assembly Rooms, the scene of the social triumphs of the celebrated Beau Nash, when Bath was at the height of its glory. The building having been burnt down in 1820, a number of gentlemen banded themselves together to form a Literary and Scientific Institution, which was opened in 1825.

The Institution comprises a museum of geology zoology, archæology, and ethnology, which is primarily designed to illustrate the county of Somerset and the district round Bath, and a library of standard English literature,

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A meteorological Observatory is maintained in the grounds adjoining, and records are taken and published periodically. The Bath Literary and Philosophical Association hold their meetings here during the winter months, when lectures on various subjects, literary and scientific, are given. The Institution is also the headquarters of the Bath Antiquarian and Natural History Field Club, who organise interesting rambles into the country around during the summer.

The library contains about 15,000 volumes. In 1869 the Rev. Leonard Jenyns, M.A., F.L.S. (who has since taken the name of Blomefield), presented his library of natural science, numbering about 2000 volumes, and herbarium of British plants, in 40 folios, to the Institution, and for this donation a separate room, known as the "Jenyns Library," has since been built. Very recently a botanical library of 400 volumes, with an extensive general herbarium, has been bequeathed by C. E. Broome, Esq., and these are now placed in the chess-room, where also is the interesting Chapman Collection of Local Literature, lent by the Corporation of Bath.

The Museum proper occupies the south side of the Institution. The arrangement is a composite of the large-hall and small-room systems. The special feature of the Bath Museum is the Charles Moore Geological Collection, which is placed in the large museum.

Upon entering the Museum, either by the front portico on the North Terrace, or by the side entrance from the Terrace Walk, we are at once surrounded by evidences of the antiquity of the city, for in the vestibule and lobbies leading to the large room we find a number of the larger Roman antiquities which have at different times been dug up in the city and neighbourhood. These interesting relics of ancient Bath belong to and have been lent by the Corporation. They include a number of votive altars, sepulchral pillars, and inscribed slabs, with fragments of the cornice frieze and pillars of temples of Minerva and Luna (?), a finely-sculptured head from the pediment of a temple, fragments of masonry and pottery, stone coffins and bronze ornaments. Copies of the inscriptions, with suggested restorations and translations by the Revs. J. Hunter and H. M. Scarth, are appended. In the conversation room of the library there is a very fine antique bronze head, probably of Apollo, also found in the city.

The collection of fossils in the large room of the Museum formed by the late Charles Moore illustrates the geology of the district in an admirable manner, and exhibit the patient and unselfish labor and research of a citizen of Bath whose life was devoted to science. At his death the Committee were enabled by a public subscription to purchase the collection. The greater portion of this collection is contained in the table-cases on the lower floor. Amongst the most noteworthy of the specimens are the great fossil *Enaliosaurians*, from the lias, which are suspended on the walls, and the remarkably fine reptiles, *Ichthyosaurus* and *Pelagosaurus*, &c., and fishes, *Lepidotus*, *Pachycormus*, and *Leptolepis*, &c., and the fossil cuttle-fishes, with their inky secretion, and drawings made with pigment from the same—all from the nodular upper lias limestones of Ilminster. The lias collection alone numbers over a thousand specimens, and includes many original or type-specimens of Moore among the mollusca, and of Duncan among the corals. The rhœtic collection is also remarkable for the innumerable teeth and scales of fishes, and teeth of the oldest mammals, *Microlestes antiquus* and *Moorei*. There is also a special collection of recent and fossil *Brachiopoda*, including many of Davidson's types, especially among the *Jurassic Thecididæ*, *Craniadæ*, and *Discinidæ*. A general mineralogical collection, presented by the late Mr. Frederick Field, is placed here.

In the upright wall-cases along the gallery will be found some interesting vertebrate remains from the high-level river gravels of the River Avon, at various points in the neighbourhood of Bath, including the tusks and molar teeth of *Elephas primigenius*, and various bones of the bos bison and musk ox. An adjoining case contains an interesting series of specimens from Kent's Hole, Torquay. Here also are placed for convenience a series of coal plants from the Radstock coal field, and some of Moore's liassic saurians, with illustrations of the upper lias saurians and fishes. The tertiary fossils are placed in flat cases in this gallery, but at present they are only partially classified.

In one of the upper rooms is a small general zoological collection, and a long gallery upstairs contains the "Godfrey Ornithological Collection," a fine series of some 1,500 birds, selected for beauty of plumage, and arranged in groups, but scientifically classified. This latter collection is lent to the Institution by the Corporation. At the end of this gallery we reach what is, perhaps, the most interesting of the Natural History Collections, in a room called the "Duncan Museum" of Local Natural History, in honor of the late Messrs. J. S. and P. A. Duncan, of Bath. Here are arranged an interesting series of mammals, birds and birds' nests with eggs, reptiles and fishes, butterflies and moths, shells and fungi, all of which have been found in the county of Somerset, or in the adjoining counties in the district round Bath. These collections have all been arranged by the Rev. Leonard Jenyns, who has also placed in this room the fine collection of British shells made by himself, and another of this famous naturalist's generous gifts to the Bath Museum.

On the left side of the vestibule on the ground floor is the "Lockey Room," containing the authropological and historical collections. Amongst these will be noticed an interesting series of objects, comprising the remains of vertebrate animals, pottery, flint implements and bone needles, &c., from the Swiss lake dwellings. These relics of early man in Central Europe have been classified by Dr. Ferdi-

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nand Keller, and was presented to the Institution by the Rev. H. H. Winwood, M.A., F.G.S., a gentleman to whose untiring and generous supervision the Bath Institution is mainly indebted for the present excellent condition of their Museum. On the right side of the vestibule is the "Lonsdale Room." This is called after Mr. W. Lonsdale, F.G.S., who, as Hon. Curator from 1823 to 1828, arranged his own numerous geological gifts and those of other donors, which are placed here as he left them. In this room also is placed a cabinet of Roman coins and various small articles of Roman pottery and iron, which have been found in the neighbourhood.

From what has been said, it will be seen that Bath Institution provides a very large amount of matter that should be of the greatest interest to students in the district, and affords facilities for gaining knowledge which should be extensively utilised.

The Museum, which is within five minutes' walk of the Great Western Railway Station, is open on all weekdays from 11 to 4; on Mondays, Wednesdays, Thursdays and Saturdays, admission is free; on Tuesdays and Fridays a charge of Sixpence is made.

Theories of Mountain Formation.

By T. Mellard Reade, C.E., F.G.S., F.R.I.B.A.

Part I.

THE origin of the surface features of the earth has always been a subject of interest to observing and thinking men. Some of these features—such as, for instance, deltas—were from a very early age recognised as the work of agents still in force. The delta of the Nile, it was obvious, even to Greek philosophers unaccustomed to geological reasoning, had been laid down by the river itself. Rounded pebbles found in the rocks, it was correctly inferred, had been so shaped by moving water.

Such geological inferences as these have been probably, to a greater or less extent, common to all historic time.

It is also a peculiarity of the human mind that it must frame hypotheses to account for what it sees. The first formed, of course, are little better than shrewd guesses at truth; but it would be difficult to point to any existing theory which had not been to some extent guessed in the hoary past, and thus limited we may correctly say "there is nothing new under the sun."

To those who understand the processes of scientific discovery it is hardly necessary to point out that there is no such thing as absolute truth. Explanations of phenomena must take their shape and color from the state of science at the time, and, while no explanation is absolutely true, on the other hand few are absolutely false. As a rule, there is some small kernel of truth to be found in every attempt made by a reasonable man to explain to himself what he sees.

It is only within the last hundred years that geology has been systematically studied, so that if theories relating to the formation of the surface features of the earth have been crude and undeveloped it is only what might have been predicated of them. A true theory must take account of all the phenomena found in connection with the effect it professes to explain. How, then, could this have been done of the crust of the earth before the nature of that crust had been approximately ascertained?

Having been asked by the Editor of *Research* to lay before its readers my views on the origin of mountain ranges—a subject to which I have devoted many years' study—I have thought it necessary to make these preliminary observations that they may be in a position to judge and test the value of what I urge. Though I fully believe that the theory which will be hereafter set forth contains a central truth, I am far from saying that the progress of science, which is so rapid nowadays will not considerably modify it. The theory in question is scientifically set forth in detail in my work, published in the latter part of 1886;* but a short general view of the leading points dealt with may be of interest, and prove instructive even to those who may possess the book.

Doubtless the primitive idea of the origin, not only of mountains, but of valleys, is that still held by people who have not thought much on such subjects, that they are due to "convulsions of nature," and earthquakes and volcanoes are pointed to as remnants of forces which acted with greater intensity in former ages. It is, therefore, rather interesting to find, in the travels of Sir John Mandeville, the following rather different attempt to account for the origin of hills and valleys. "And thus have mountains and hills been and valleys, which arose only from Noah's flood, that washed the soft and tender ground, and fell down into valleys, and the hard earth and rock remain mountains where the soft and tender earth was worn away by the water and fell and became valleys."

We have only to substitute "subaerial denudation" for Noah's flood and we have to a large extent the modern notion of the origin of these surface features as first systematically developed by Hutton.

Avicenna, an Arabian physician of the tenth century, writing on the cause of mountains, says "some are formed by essential others by accidental causes." A violent earthquake, by which land is elevated and becomes a mountain is an illustration of the "essential." Excavation by water, by which cavities are produced and adjoining lands made to stand out and form eminences, is an illustration of the "accidental." Confined air seeking vent, by which plains have been upheaved into hills, is one of the geological ideas Ovid credits Pythagoras with.

Probably most people's elementary ideas now go very little further than the foregoing. I confess that I studied geology myself for many years without having anything but the haziest notions on the subject. That grand work, Lyell's *Principles*, to which geology and geologists are so much indebted, is unsatisfactory on the subject of the origin of mountain ranges, inasmuch as it is more of the destructive than constructive order. Lyell plainly sees and shows how the theory of Elie de Beaumont, the only systematic theory then in existence, was in conflict with geological facts; but in my opinion Lyell fails, or, rather, does not try, to formulate any theory which may take its place.

It appears that the idea underlying de Beaumont's theory had occurred long before to Sir Isaac Newton. He suggested that the cooling of the interior of the earth would produce compression in the outer crust through gravitation, as the crust in following the shrinking centre would be compelled to adapt itself to a less extensive area; hence ridges or mountains would be thrown up. This in the crude form is the idea underlying what is called the "contraction theory" of mountain formation, which has hitherto occupied perhaps the first place as an explanation of the origin of mountains. It is true that many geologists have been inclined to place expansion by heat as a cause more in conformity with geological fact, and it was long since pointed out by Babbage, Scrope, and Herschell that the laying down of sediment would of itself cause a rise of temperature in the crust, in the same way that a top coat or blanket does in the human body.

The theory was, however, never by them sufficiently developed to take the place of the earlier "contraction theory," which has held its own as apparently invoking the only cause known sufficiently potent to

* *Origin of Mountain Ranges, Considered Experimentally, Structurally, Dynamically, and in Relation to their Geological History.* Taylor & Francis.

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account for such grand features as mountain ranges, though Captain Hutton, of Christchurch, New Zealand, pushed the reasoning further in a very suggestive paper published some years back in the *Geological Magazine*.

The contraction theory, as stated by its exponents, was doubtless sufficient—and, indeed, as Lyell pointed out, much more than sufficient—to account for the upheaval of all the known ranges, considered as so many cubic miles of rock.

Notwithstanding that so many mathematicians and physicists had worked at the problem, the underlying idea was that the *whole* of the solid crust of the earth—a very vague term—must be in compression by the cooling of the nucleus, the favourite illustration being taken from the apple in which the core consisting of the fruit contracts by drying, while the rind remains of the same dimensions, or nearly so, and is thrown into wrinkles. Who does not remember the familiar "wrinkled hand" photographed in Nasmyth and Carpenter's work on the Moon, as another illustration, though the appositeness of the analogy is, to say the least, doubtful? That most supporters of the theory without further inquiry accepted the position that all the rigid crust of the earth must be in compression is sufficiently evidenced by the remarks in Prestwich's *Geology*, vol. II., p. 540 (1887), where even the possibility of a shell 800 miles thick being in compression is discussed but rejected. Prestwich, along with some other geologists, thinks that the hard crust of the earth rests upon a semi-fluid zone, and that the whole of the crust, whatever thickness it may be, is in compression. Although this is not always expressly stated by the upholders of the contraction theory, it, so far as my acquaintance with the subject extends, inferentially forms the basis of their reasoning. At any rate, whether considered partially fluid or solid throughout, the earth they assume to be divided into a contracting nucleus and an uncontracting crust, and we are left to put any quantitative value we like upon either. This may be seen by a reference to Geikie's *Text-Book of Geology* and Green's *Physical Geology*, both justly considered standard geological works.

In my *Origin of Mountain Ranges*, published towards the end of 1886, I pointed out that the crust of the earth, whatever thickness we assign to it, must, on the assumption of secular cooling, excepting at the surface, be itself contracting. If we assume the earth to be solid throughout, and to be divided into a series of thin shells, each under shell, commencing with the one immediately below the surface, will circumferentially contract more than the one above or enclosing it until the zone of maximum contraction is reached, when the underlying shells will contract less than those overlying them, till a depth is reached at which there is practically no contraction. As the earth is cooling from the outside, and the mean increase of heat downwards is about 1° in 60 feet—and even less, as estimated by some authorities—a simple calculation will show that the cooling of the body of the earth is now of only a superficial character, not, practically speaking, penetrating above 200 miles. From this it will be seen that the radial contraction of the earth is limited to the depth to which it has cooled from the interior, and therefore the apple illustration, where the core contracts *throughout*, is quite misleading.

Vague general statements instead of quantitative determinations are responsible for much inconclusive geological reasoning.

It may be almost taken as an axiom that physical reasoning without quantitative determination is, more often than not, quite misleading. But, to return from this digression, it is readily seen that the radial contraction of the earth must be of limited quantity, and, this being so at a certain calculable depth, the mean rate of circumferential contraction must be equal to the mean rate of radial contraction.

The shell at this depth, whether the nucleus be fluid or solid, will be neither in compression nor tension, while all above will be in compression and all below in tension. Speaking exactly, this neutral zone may be looked at as a shell infinitesimally thin, and it has been appropriately named by Mr. O. Fisher the "level of no strain." The whole of this reasoning, with an illustrative diagram, may be seen in Chapter XI. of my *Origin of Mountain Ranges*, and it is there shown that this zone or level-of-no-strain in our globe, cannot be situated many miles below the surface.

Since my chapter was written the subject has been investigated by Davison, Darwin, and Fisher. The first of these mathematicians contributed a paper to the Royal Society, in which he estimates that the level of no strain is now, after the lapse of about 174 million years, about five miles deep, while Darwin places it at two miles deep in 100 million years since consolidation, and the Rev. O. Fisher at less. My own calculations agree pretty closely with the two latter, but the depth will vary according to the assumed data of consolidation, co-efficient of expansion of rock, &c., upon which the estimate is based. The agreement of these independent investigators is, however, remarkable.

Theoretically, the depth of the level-of-no-strain varies as the time, and the amount of rock crushed may be represented by a cone the base of which is the difference in area between the surface of the globe before and the surface after contraction, having a height equal to the depth of the level-of-no-strain. It will thus be seen that the cubic quantity of rock crushed will be only one-third of what it would be with a crust the thickness of the depth of the level-of-no-strain and unaffected by cooling in its own substance. It follows from these various considerations that the compression of so thin a shell is inadequate to account for the upheaval of mountain ranges as we see them upon the earth, and that geological facts are eloquent against this explanation of what is colloquially called "mountain building."

An examination of most great ranges show that they have a central core of gneissic and granitic rocks forced up through the overlying sedimentaries, which are folded into loops between the intrusive tongues gneiss.

The phenomena of mountain structure lead us to the conviction that the lateral pressure increases with the depth instead of diminishing, as it should do on the contraction hypothesis.

It is from these considerations, together with a wide range of geological inferences, that lead me to reject the contraction explanation of mountain formation, and to seek for another more in conformity with nature. In a future number I propose to give an outline of my own views as to the structure and origin of these great corrugations of our earth.

THE HIGHER EDUCATION OF WOMEN.—Recent reports show that ladies are fast achieving honorable distinction in fields of intellectual labour. No fewer than twelve students of the London School of Medicine for Women presented themselves for the first and second examinations of the Royal Colleges of Physicians and Surgeons of Edinburgh, and all passed. Miss Waterson, M.D., formerly a student of the London School of Medicine for Women, has just passed the examinations of the Psychological Society for a certificate in mental diseases. Miss Waterson is the first lady who has presented herself for this examination. "Beyond the border" we learn also that women have done fairly well in the examination instituted by the University of St. Andrews for the diploma of Lady Licentiate. Five hundred and fifty-three candidates presented themselves at twenty-four different centres, and at these 126 passed in all the subjects required for the diploma. Since these examinations were instituted in 1877, 1,674 candidates have entered, and 693 have obtained the degree of LL.A. From the Sister Isle similarly encouraging intelligence comes to hand. About a dozen Irish ladies have succeeded in passing the recent examinations for the degree of B.A., and Miss Letitia A. Walkington, Master of Arts of the Royal University, Ireland, has had the distinction not only of being the first lady graduate in arts, but also the first to take a degree in laws, having passed most creditably, after private study, the examination for LL.B. just held in Dublin.

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Valleys, Ravines, and Underground Streams.

IN an article in our last number on Buxton we incidentally mentioned the suggestion of Professor Phillips that some of the deep valleys in that locality were originally underground channels through which streams ran, and that river and atmospheric action had worn away the roofs until they had fallen in. One of the localities selected for one of the excursions of the British Association during the forthcoming meeting in Bath is to a neighbourhood that may well afford opportunity for the study of valleys and gorges in connection with caverns and underground streams, viz., Cheddar. Here is a deep, narrow winding gorge, or pass, in the Carboniferous Limestone of the Mendip Hills, the rocky sides at some points being fully 400 feet above the level of the road. Our illustrations of "Cheddar Cliffs," from photographs taken by Mr. J. Webber, of Wells, will give some idea of the nature of this pass. Professor Boyd Dawkins holds similar views with regard to this pass to those of Professor Phillips above alluded to, and considers the pass as an old cavern of which the roof has been denuded.

In the immediate neighbourhood are numerous fissures and caverns, some of considerable size. What is known as "Cox's Cave" has long been famous for the beauty of its stalachtites and stalagmites, some of which assume very curious forms. Another cavern, discovered not long ago by Mr. Cox-Gough, is of considerable extent, and offers many interesting features worthy of attentive study.

There is still another important cave a few miles away at Wookey Hole, near Wells, and close by here are the Ebbor rocks, which present features much resembling those noticeable in the Cheddar pass.

It is almost impossible on studying these localities to come to any other conclusion than that the agencies that formed the caverns assisted also in the formation of the fissures or passes, many of which exist amongst the Mendips, and there, further, can be no doubt that the chemical action of water impregnated with carbonic acid, has assisted greatly in producing the caves. It is obvious, also, that mechanical disintegration has largely assisted the chemical action, and that the latter has to some extent exerted a building-up as well as breaking-down agency by depositing carbonate of lime, owing to loss of carbonic acid and evaporation. It is again evident that the matters disintegrated have been largely removed by underground streams, for both at Cheddar and at Wookey there issue streams of considerable volume from underneath. Our illustration of Wookey Hole Cavern, taken from a photograph by Mr. T. W. Phillips, of Wells, shows the outlet, which is of somewhat basin form with dome shaped roof, the appearance of the aperture resembling much that of the Peak Cavern in Derbyshire, the Clapham Cave in Yorkshire, and others which indicate disintegration largely brought about by water action. Wookey Hole Cavern, the entrance of which is in the Dolomitic Conglomerate, extends for nearly 600 feet into the hill, and contains one chamber about 80 feet high.

CHEDDAR CLIFFS.

The distance traversed by these underground streams is considerable. It has been suggested, with much probability, that much of the water which issues from the cavern finds its way underground from what are termed "swallet" or "swallow" holes near Priddy, at a point some few miles away on the Mendip Hills; and that the stream at Cheddar has its source at Charterhouse, on the south-west flank of Blackdown; but, as may be supposed, both streams receive many tributaries during their underground course.

Studying the character of the strata, the nature of the underground streams, the chemical and mechanical agencies that are still

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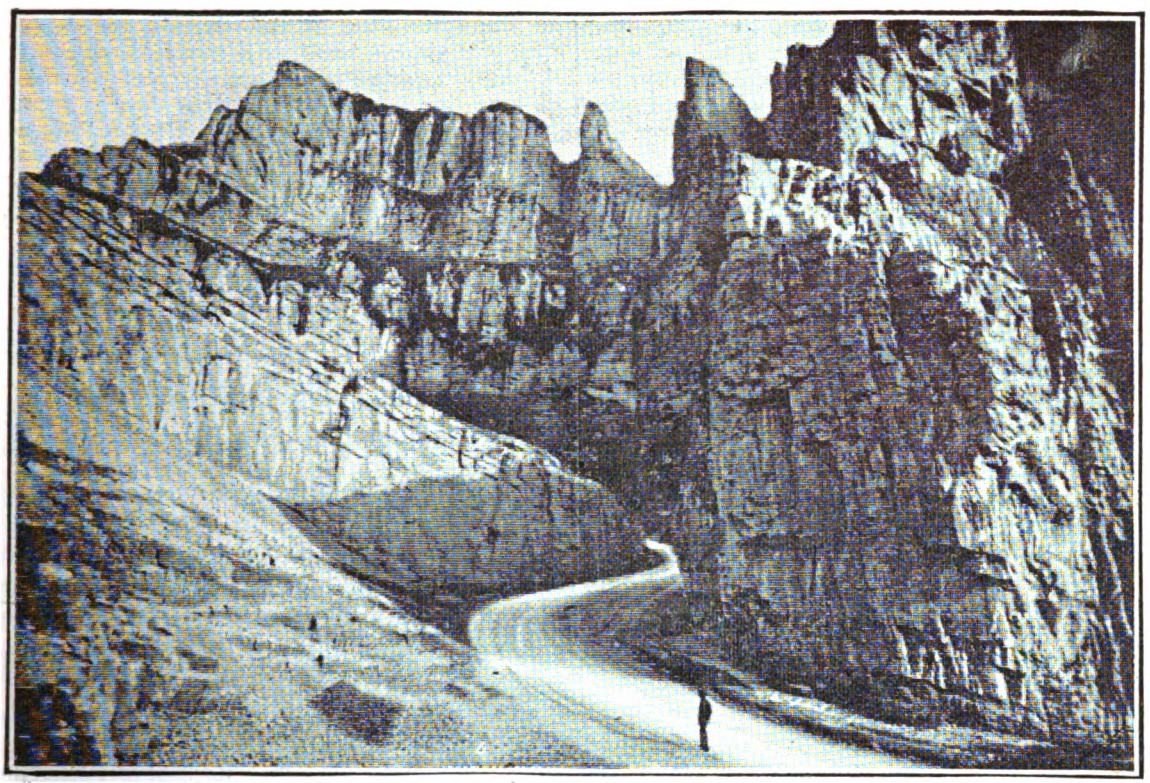

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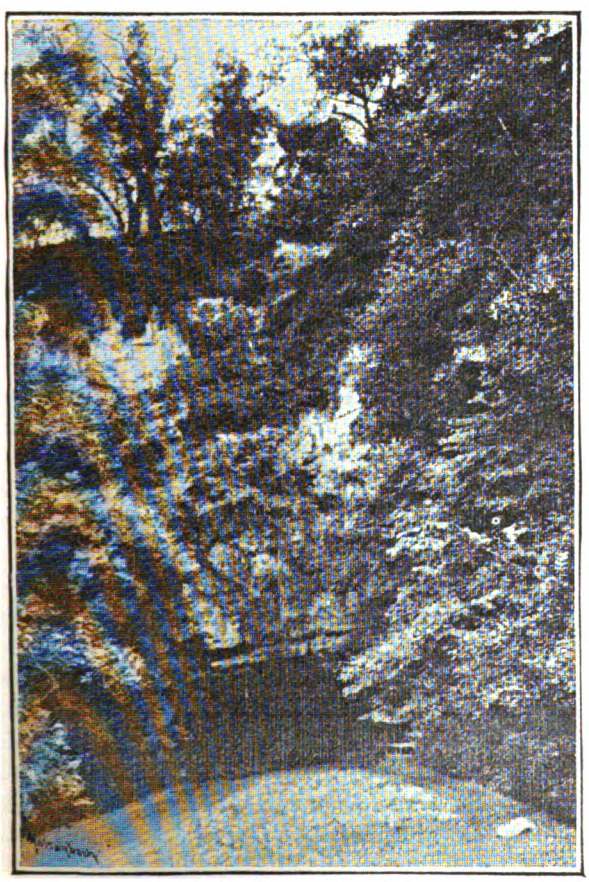

WOOKEY HOLE CAVERN

at work in the caverns and underground fissures, and the subaerial actions on the surface, it is evident that the views of Professor Phillips and Professor Boyd Dawkins are well calculated to explain the formation of such gorges as that at Cheddar, and at other points amongst the Mendip Hills. They are, at any rate, worthy of attentive study, and it is to be hoped that during the ensuing visit, they will, with others, be well investigated and discussed.

We cannot close this brief sketch without reminding our readers of other caverns not far from Cheddar, viz., those at Banwell, Uphill, and in the neighbourhood of Weston-super-Mare. These are well worth visiting, and have already often afforded much that is valuable to the geologist.

The Animal Alkaloids.

IT is now more than thirty years ago since Panum first called attention to the fact, that animal matter which had become decomposed by putrefaction contained a poison of great activity, although he could not define its nature or chemical composition. That putrid matter contained such a poisonous principle appears to have been noted also by Liebig in 1843, who states, *"There is a peculiar class of substances generated during certain processes of decomposition, and which act on the animal economy as deadly poisons."

Very little further light was thrown on this interesting subject, until 1870, when Selmi, in examining the body of a subject supposed to have died from the effects of poison, detected an alkaloid, which he was unable to identify with any of the bodies of that class then known. On further research and examination, he was led to believe that it was possible for the stomachs of persons who had died from natural causes, to contain poisonous substances similar to the vegetable alkaloids, and that their presence and formation was probably caused through the process of putrefactive decomposition.

* Liebig's "Chemistry Agricult. and Physiology,' page 363.

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In 1877, Selmi conclusively proved that albumenoid matter undergoing putrefaction originated the poisonous alkaloids he had met with, and he succeeded in separating two of these bodies. About the same time, Gautier in France had been pursuing the same line of investigation, and was able to confirm Selmi's results by confirmatory discoveries, and a few years later he isolated and defined several others.

From their investigations, they concluded that after death in animal matter, the distructive process of decay at once begins, and results in bacterial fermentation or putrefaction. These alkaloids are the outcome and result of that putrefaction, also, that the quantity of alkaloid elaborated becomes greater as decomposition advances.

These animal alkaloids are divided into two classes, viz., Ptomaines, or cadaveric alkaloids, which are the direct product of putrefactive decomposition in dead animal tissue; and Leucomaines, or vital alkaloids, those that are formed in the living animal tissues. Although most of the cadaveric alkaloids are of a strong poisonous nature, others have apparently little or no toxic effect. Between the ptomaines and leucomaines, there is a close affinity, both having their origin in albumenoid substances. The ptomaine base is solid or liquid, and has a distinct alkaline reaction. The solids generally exist in a white crystallised form, and are soluble in water. Of those that have been isolated and definitely analysed, we have, to begin with, Parvoline, one of the first discovered, an oily liquid of amber color, and was extracted from the putrid remains of mackerel, and horseflesh. Hydrocollidine has also been isolated from mackerel, horse, and ox flesh. It is a clear liquid, of an oily nature, and a violent poison, even in very minute quantities. It is stated to be as powerful as the venom of the cobra da capella, 0.0017 gramme having been found sufficient to cause death, when injected into a small bird.

Collidine has been found in the putrefactive products of bullock pancreas and gelatine, and Neuridine has been extracted from decayed flesh, fish, cheese, and also from the human body.

Cadaverine and Putrescine, both colourless liquids, have been isolated from herring brine. Mydaleine is a powerful toxic agent, its physiological effect causing violent diarrhœa, vomiting, and death. Neurine, another active poison, and Choline, the latter being extracted from bile, may be elaborated during life, and is therefore both a ptomaine and a leucomaine.

Muscarine, a solid crystalline substance, also a violent poison, has been isolated from putrid fish. It is identical with the vegetable alkaloid, from which the toad-stool derives its poisonous effects.

Gadinine, a crystallised solid, is the putrefactive outcome of codfish. Other alkaloids have been detected, but have not yet been isolated in sufficient quantity to define their exact composition.

It may be judged from the foregoing enumeration of these ptomaines that have been discovered and named, what progress has been made within the last few years in this interesting group of alkaloids. On investigation with regard to their physiological character and effect, the majority are found to be poisons, and many of a very violent nature.

From a medico-legal point of view, their importance cannot be over-estimated. Many mysterious cases in which the cause of death has never been satisfactory solved, may now, to a certain extent, possibly be explained. Several instances are on record in which ptomaines have been proved to be present in the organs of the human body, when a *post-mortem* examination has been made.

Brouardel and Boutmy some four years ago detected a ptomaine, in examining the remains of some decomposed goose that had been eaten by a number of persons, one of whom succumbed to the effects. The same alkaloid was also extracted from some of the organs of the deceased person.

Unfortunately, as regards the color reactions of the animal alkaloids, they are as yet very incomplete, and no reagent has yet been found to distinguish one general group from another.

The Leucomaines, or vital alkaloids, are elaborated in the living body, and have been found in our muscular tissues. It is argued that they may give rise to disease by accumulating in various parts of the system, and thus poisoning the healthy organism if not got rid of. Whether this assertion is correct or not, it is a fact that many of the leucomaines, like the ptomaines, are of a distinctly poisonous nature. They have been extracted from the blood, spleen, intestines, and other parts of the body and its secretions.

Sufficient may thus be gathered of the important part the animal alkaloids are destined to play in the science of chemistry and medicine in the future, and although, as yet, they are comparatively but little known, they have already had a considerable influence on scientific research.

C. J. S. THOMPSON.

Our Portrait Gallery.

III.—REV. W. H. DALLINGER, LL.D., F.R.S., F.L.S., &c.

THE Rev. Dr. W. H. DALLINGER was born at Devonport in 1841, and is the son of Mr. Joseph S. Dallinger. He was educated privately, and in 1861 entered the Wesleyan ministry and was stationed at Faverham, Cardiff, Bristol and Liverpool, leaving the latter place to undertake the important duties of the governorship of Wesley College, Sheffield, a position he has filled until very lately with conspicuous success, the appreciation in which he was held whilst in the latter position being well shown in the presentation last month at a public meeting in Sheffield of a handsome testimonial from a number of present and former inhabitants of the town, "in recognition of his invaluable services to the town, not merely as a minister of religion, but as a man of science and as a powerful contributor to the cause of education in its highest and largest sense." Dr. DALLINGER'S scientific work has been more especially connected with biological investigations conducted by the aid of the microscope, his attention having been given particularly to the life-histories of minute forms of life. His work in this direction has had a most important bearing upon microscopy. His desire to work with the microscope only when fitted with the most perfect lenses and mechanism, has given such a wonderful stimulus to opticians and others that rapid strides have been made of late years towards perfecting that instrument. What microscopy means to Dr. DALLINGER is pretty clearly shown in a letter accepting an invitation to be an honorary vice-president of the Carlisle Microscopical Society, in which he says "The *raison d'etre* of the modern microscope is its scientific employments. This can only be the result of a complete mastery of the instrument in all its details." He proceeds to describe a master of his lenses as one who is "able to make them obey him without difficulty, yielding precisely the results he wants, and not wanting anything from them that they cannot yield; making the utmost and best use of aperture, collar, and fine adjustment; and knowing accurately what eye-piercing any lens will admit of. These and many other things are of the utmost importance. But they imply steady effort and practice; these, with a fair

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THE REV. W. H. DALLINGER, LL.D., F.R.S., F.L.S., &c.

From a Photograph by Barraud, Liverpool and London.

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knowledge of the construction of the instrument, are the keys to success, and they can be acquired by any resolute man. But, beyond this, the management of light and illuminating apparatus is of the first importance. If anything, this is more difficult to fully master than the efficient employment of the lens; for the use of the lens to its utmost capacity depends upon it. But it is equally within the reach of the resolute. It is when a man is master of his microscope, as the skilful organist is of his organ, that he will enter, without hesitancy and with certainty of result, upon such investigations as in every department of biology, and indeed of science, invite the interest and effort of the microscopist."

The resolution to work only with the most perfect apparatus, to know each part of it thoroughly and what it is capable of, is characteristic of Dr. Dallinger, as is also his determination to mark out clearly what it is he intends to investigate and how to proceed with the investigation, to test fully each step of his progress, and to keep unremittingly to the work with the most resolute patience. As a consequence all his researches are models of patient, systematic work, directed by an evident desire towards thoroughly truthful results. One of the earliest of his researches on minute forms of life, made in conjunction with Dr. Drysdale, of Liverpool, is a splendid example of steady, untiring industry in careful scientific investigation, and all others that he has since made are of the same character. One, especially, of his latest addresses—his presidential address to the Royal Microscopical Society—is a most interesting record of important micro-biological work, and its results cannot fail to stimulate other inquirers.

Dr. DALLINGER has not only been an investigator, he has discoursed on his researches at the Royal Institution, London, at Oxford, and in numerous other places, and as a lecturer he has always commanded the greatest attention by his clearness of style and the importance of his subjects. His work in this direction has been recognised by his appointment to the Rede Lectureship of the University of Cambridge and as a lecturer in connection with the Gilchrist Trust.

His scientific work has been acknowledged on several occasions. His earliest researches were rewarded by an unsought grant of £100 from the Royal Society for further investigations. In 1880 he was elected a Fellow of the Royal Society; and in 1884 received the Honorary Degree of LL.D. from the Victoria University. In 1885 he was elected President of the Royal Microscopical Society, a position he held for some years, the laws of the Society having been suspended by special vote to allow of his re-election.

Dr. DALLINGER is not only a scientific man, he is also a minister of religion. The times are not now what they were even a few years since, when unseemly conflicts between "religion and science" were frequent and bitter, although no doubt there are many at the present day who on the one hand adhere to dogmas that pass for religion, and others who hold to scientific views equally dogmatic and untenable upon investigation, who would still fight on.

But Dr. DALLINGER, whilst holding a high position as minister in one of our largest religious bodies, has in his scientific investigations gone straight forward with his work, simply seeking for the truth. His views as to the spirit that should guide in matters both of religion and science seem to be indicated in the following quotation, from an introduction to a small work written by the Rev. N. Curnock, entitled "Nature's Musings," in which he says—"The tendency of the scientific specialist is to scientific narrowness. He must read and know broadly beyond his facts as an expert if he would maintain a truly scientific spirit. But religion which reduces itself to a mere series of states and experiences, is equally in danger of losing the essential idea involved in religious manhood. Body, soul, spirit, one man, that is the area over which spiritual religion must reign; these are the many sides of the lamp through which noble Christian light is to shine, and in the study and knowledge of Nature we have but one of the many channels in which it is the highest privilege of the Christian mind to exercise itself."

The work of such a man is not only of great value to science, but should serve to convince those who are too much trammelled by dogmas and creeds that thorough investigation, with determination to sift strictly all evidence and extract only that which can be proved true, is the best road to sound religious belief and conduct.

On Circulating Cabinets in connection with Museums.

IN November, 1883, it was suggested to the Committee of the Free Public Museum of this City that it would be desirable to provide for the School Boards, and such schools as are supported by voluntary contributions, a series of Cabinets, each containing a group of specimens suitable for the illustration of *Lessons* on vertebrate animals, animals without bones, plants, fossils, minerals, and economic products. These cabinets were designed, under certain regulations, to be circulated by the Museum. The plan has now been in operation for four years, during which the work has never been intermitted except during the holidays; and the Committee consider that they have reason to be much satisfied with the reception and co-operation given to the effort by the school authorities and teachers in Liverpool.

Soon after commencement it was found that sixty-four schools had asked to be regularly supplied with the cabinets, of which sixteen were prepared and in readiness. Two or three of them may be briefly described. Coal Cabinet, size 17 × 17 × 12 inches, five trays of boxes, containing altogether twenty-five specimens: bog-moss, peat, club-moss, lignite, jet, cannel-coal, anthracite, bitumen, paraffin, rock-oil, coal, cone-in-cone coal, peacock-coal, fossils found in the roofs of coal-mines, fossil fronds of ferns in coal-shales, lake-pitch from Trinidad, coal from Greenland, thin sections of coal for use with a lens, scoria from a burnt coal-mine. Not one third of these are, however, indispensable for a really good circulating coal cabinet; but active teachers love to have plenty of pegs on which to hang their nets. Bird Cabinet: This is one

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of the largest in the series, and in extent is 32 × 17 × 16 inches. No names need be quoted, for it would be a most unfortunate selection of birds that should not be popular with young learners. But the adventitious objects give rich scope for the teacher, *e.g.*, nests of birds, and their arbours for play. Special parts should be prepared—the feathers and the wings, to show the exquisite arrangement in the tiers of quills; the foot of a swan, for comparison with that of a heron and the talons of a bird of prey; a merry-thought bone, and half a dozen kinds of bills for guessing out the different kinds of birds to which they belonged. Teachers will, no doubt, adopt various methods in giving instruction from the specimens at their disposal; but the cabinets are designed to train rather than to teach—to promote perception, observation, comparison—to encourage the observing eye and the admiring loving heart; and where these are developed, knowledge with its best fruits will not be far behind.

But should it be thought that circulating cabinets must necessarily be restricted to large centres, I may venture to offer an opinion to the contrary. As the application of the scheme grows wider, the cabinets are found to serve for fresh uses. The Public Museum cabinets are becoming much in demand for purposes not originally contemplated, *e.g.*, for soirées, for social parties of church-choir or Sunday school workers, and for meetings of improvement societies. Two of the cabinets have recently been returned from a Midland Educational Congress. In the case of poor and small towns, it is perhaps the most feasible mode of commencing a museum for the public. Each of a few friends might undertake to provide a cabinet, not for self gratification, but for disseminating the enjoyment which nature generously affords to every honest collector. A common shelter for the boxes would soon be found, and the circulating cabinet would prove to be a museum in embryo.

HENRY H. HIGGINS.

Free Public Museum, Liverpool.

Museum Notes.

ONE of the recent additions to the Liverpool Free Public Museum is the nest of a "Tree Trap-door Spider," from Graham's Town, South Africa, presented by Mr. Frederick Taylor, of Rainhill. This specimen, which has been placed in the case containing a large collection of spiders and their nests (also the gift of the same gentleman), is almost unique in this country, only one previous example of the kind having been brought before the notice of entomologists in England. The nest has been mounted by Mr. Chard. It differs somewhat from the nests of other "trap-door spiders." A full account of the habits of its builder will be found in a paper read before the Zoological Society of London, in 1887, by the Rev. N. Abraham, communicated by Dr. A. Gunther, F.R.S., who has named this spider *Moggridgia dyeri*.

AT the Queen's Park Museum, Manchester, there is now on view by the kindness of Councillor Boddington, an interesting loan collection illustrating the musical instruments of ancient days. Here may be seen the lyre, lute, claricle, cittern, spinnett, dulcimer, and harpsichord. The various devices for producing and controlling the sounds deserve attention.

A WELL-KNOWN official of the Botanical Department of the British Museum—Mr. H. N. Ridley, F.L.S., has just been appointed to the charge of the Botanical Gardens at Singapore.

THE death is reported of Miss Glanville, one of the few ladies who have occupied the responsible position of Curator to a Museum. This clever and accomplished young lady discharged her duties most conscientiously and ably, and did much to promote an interest in science at the Cape of Good Hope. Miss Glanville's labours were chiefly devoted to the Albany Museum at Graham's Town.

THE British Consul at Antwerp has issued a Report of the Antwerp Commercial Museum, which ought not to be neglected by British manufacturers, if only as an indication of the efforts of our Continental neighbours to promote maritime commerce. The institution is an outcome of that movement for developing new markets, and particularly Colonial markets, which may be said to have been inaugurated by the great Exhibition at Amsterdam five years ago, and it is also an expression of the increasing interest in commercial education and in emigration as means for maintaining national prosperity and relieving congested markets. The project, we are told, was first mooted in connection with the Antwerp Exhibition of 1885, which, like our own Indian and Colonial Exhibition, was suggested by the similar Amsterdam enterprise of 1883. The nucleus of the Museum was the handsome and spacious building in which the French colonial exhibits were displayed, presented to the town for the purpose by the French Government. Annual subsidies were voted by both the municipal and provincial authorities, and the museum was opened just a year ago. Not only do the promoters aim at making known to importers and strangers visiting the port the raw or manufactured products which can be obtained there, but they aim at increasing local knowledge of the geography and characteristics of actual and possible markets beyond the seas. One very interesting feature of the institution is an Intelligence Department for the information of intending emigrants. It is significant, as showing what is being done abroad in this direction, that there are no less than three other Commercial Museums in existence at Antwerp. It would appear from the Report of the Consul that but few exhibits have been received from Great Britain and India, though Belgium, Germany, Portugal, Spain, Turkey, as well as France, Russia, Sweden and Norway, have assisted with valuable contributions to the general collection.

IT is announced that Mr. H. O. Forbes, the New Guinea explorer, and author of "The Naturalist in the Malay Archipelago," has received the appointment of Director of the Canterbury Museum, New Zealand, to succeed the late Sir Julius Von Haast.

Our attention has been called by the Curator of the Grosvenor Museum to an error which crept into our article on "Local Museums: No. 2. Chester." The number of "species" (not "specimens," as stated) presented during the year was 615. The total number of specimens added to the museum reached upwards of 1,000.

IT is satisfactory to learn that the settlement of the arrangements under which Mr. Ruskin will undertake to generously hand over his St. George's Museum to the town of Sheffield will now no longer be delayed. The Museum is at present situated in an inconvenient part of the town—at Walkley—and a new and more commodious building will shortly be erected. The collections of art-treasures, rare minerals, and precious gems, contain much that is unique and of the highest interest.

AN effort is being made to establish a Museum in connection with the Pudsey Mechanics' Institute, in which specimens of the commercial and industrial productions of that important manufacturing district will be deposited for inspection and study.

THE remarkable collection consisting of nearly 100 Roman inscribed stones and fragments of buildings, recently found during excavations in the North Wall at Chester, is now being removed to the Grosvenor Museum. For some time, many of the stones have been housed in a shed in the Dean's field. Many a Roman antiquary will doubtless make a pilgrimage to Chester, to view these epigraphic records of the 20th Roman legion.

A BILL is at present before the American Congress appropriating $500,000 dollars for the erection of an additional building for the National Museum. The proposed building is to cover an area 300 feet square, to be two stories high, and to stand flanking the Smithsonian building in the west, as the present building does on the east.

Meteorology.

UNDER this head we purpose giving monthly records of meteorological observations at different centres in the United Kingdom. We shall be glad to receive from correspondents notes of the meteorological conditions recorded in their district. The notes must, however, be brief. This month we append reports of interest from Liverpool (Bidston), Sheffield, and Bolton (Lancashire):—

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Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between July 16th and August 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S., F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	Highest (August 3rd)	30·22	Inches.
„ „	Lowest (July 16th)	29·39	„
„ „	Mean	29·832	„
„ „	„ for 21 years July	29·937	„
„ „	„ „ August	29·928	„
Temperature	Highest (August 10th)	74·9	Deg. F.
„	Lowest (August 15th)	46·3	„
„	Mean	58·7	„
„	„ for 21 years July	61·0	„
„	„ „ August	60·6	„
„	„ of Evaporation	54·7	„
„	„ „ for 21 years July	56·8	„
„	„ „ „ „ August	56·5	„
(*b*) Rainfall	Amount	3·409	Inches
„ „	Mean for 21 years July	2·951	„
„ „	„ „ August	2·701	„
„	Number of Days on which Rain fell	20	
„	Greatest fall in 24 Hours (August 17th)	0·532	Inches
Cloud	Mean Amount (0 indicating clear sky 10 overcast)	7·8	
„	„ „ for 21 years July	6·4	
„	„ „ „ August	6·3	
(*c*) Wind	Velocity Greatest (August 13th)	48	Miles.
„ „	Least (July 31st)	1	„
„	Mean Hourly	13·9	„
„	Greatest Pressure on Square Foot (Aug. 13, 7·55 a.m.)	24·0	Pounds.
„	Direction at time of Greatest Pressure	WSW	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
58	106	104	69	130	161	91	25	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

The Weather, July, 1888.

At the beginning of July an anticyclone extended over the United Kingdom, and pressure only varied between 29·98 in. and 30·02 in. The anticyclone gave way on the 2nd, and during the remainder of the month a constant succession of depressions caused the weather to be of a very unsettled character. The following table gives the chief meteorological conditions of various places in England during July :—

	TEMPERATURE.							RAINFALL.				
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for July.* Daily Max.	Means for July.* Daily Min.	Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for July.* Ins.
Sheffield ...	70°	22d	38°	11th	55°	—	—	5·06	21	0·73	15th	—
Spurn Head.	70°	24th	42°	28th	55°	—	—	5·22	22	0·76	15th	—
York	74°	20th	41°	11th	56°	68·5	52.1	5·23	22	0·81	17th	2·57
Barrow	67°	20th	44°	11th	56°	—	—	6·99	23	0·53	25th	—
Liverpool ...	69°	20th	45°	11th	57°	66·1	54·4	4·99	22	0·76	2nd	2·99
Holyhead ...	64°	16th	43°	11th	56°	63·9	54·7	3·63	21	0·81	2nd	2·32
Oxford	72°	20th	41°	11th	58°	69·9	53·7	4·46	26	0·81	2nd	2·51
London	72°	23rd	43°	12th	59°	73·0	54·1	5·95	23	1·05	6th	2·17

* The means of Temperature and Rainfall for July are for 15 years.

NOTES.—During the first week of July the weather was in a very unsettled condition, rainfall abundant, and temperature low. Thunderstorms occurred from day to day in various localities. From the 8th to the 14th of July the weather was again of a generally unsettled character, and rain fell in all parts of the country. On the 11th and 12th, with northerly winds, temperature fell to an unusually low level the thermometer readings being unprecedented for the time of year, and on the former date slight falls of snow were experienced in many parts of Great Britain. The max. temperature of 54° recorded in London on the 11th and 12th was considerably lower than any July max. observed for very many years past. The max. temperature in Liverpool on the same date was 57°, and the highest max. in Great Britain 60° at Leith. From the 15th to the 21st the weather remained in a very unsettled, changeable state. Temperature, although decidedly higher than of late, was somewhat low for the time of year, especially during the early part of the period, but on the 19th the max. temperature recorded in England was as high as 76°. The last week of the month was again cool, changeable, and very unsettled, with heavy falls of rain in nearly all districts, and local thunderstorms. The max. temperature seldom reached 70°, and in the north the thermometer as a rule failed to reach 60°.

The week from July 29th to August 4th commenced with a continuation of the very unsettled, rainy, thundery conditions which had prevailed throughout the greater part of July. Temperature was low, the air was close, and thunderstorms and rain were general over the country. There was little change till August 1st, when, with a considerable rise in the barometer in the west, the weather began to clear at many places, but at the close of the week pressure was again giving way irregularly. During the week ending August 11th the weather was finer and drier than for a long time past, and though temperature was at first low generally it afterwards rose quickly, and on the 9th and 10th maxima exceeding 80° were registered over the Midland and South-East Counties.

Sheffield, August 17th, 1888. E. HOWARTH, F.R.A.S.

Bolton.

Latitude of observatory, 53° 35′ N.; long. 2° 27′ W. Cistern of barometer, 330 feet, and rain gauge 390 feet above mean sea level. Diameter of rain gauge, 5 inches; height above ground, 1 foot.

During the week ending July 21st the average corrected mean temperature was 56·36° = 2·6° below the average; barometer low; rainfall, 5 days, 0·884″; sunshine only 11 hours 16 minutes; and humidity 85% (complete saturation point = 100). From the 22nd to the 31st the mean temperature varied from 59·6° to 48·35° (30th), and averaged 54·34°; barometer low; rainfall, 7 days, 2·463″; sunshine 24 hours 32 minutes; and humidity 83%. The means for July :—Barometer 29·741 inches; corrected mean temperature 53·74° (about 5° below the average); total rainfall 7·915 inches; sunshine, 23 days, 73 hours 5 minutes, or only 13% of the time the sun was above the horizon; humidity 87·7% = 13% above the average. Thunder and lightning occurred on the 4th, slight, on the 5th a storm of moderate intensity, and on the 23rd of moderate intensity, accompanied by rain and slight hail—in each instance distant.

The month of August commenced cold, wet, and with distant slight thunder to the S.W. The average mean for the week ending he 7th was 53·38°; barometer unsteady, but average mean; rainfall, 6 days, 1·380″; sunshine, 5 days, 20 hours 20 minutes; humidity 80%. During the week ending August 14th a decided improvement took place. Barometer somewhat unsteady, mean average 29·981″; the mean temperature varied from 63·1° on the 10th to 52·15° on the 13th, with an average of 57·97°; rainfall, 2 days, 0·456″; sunshine, 4 days, 29 hours 40 minutes, the 14th contributing 12 hours 22 minutes; and humidity 82%.

The period under review has been remarkable for the slight amount of ozone in the locality.

W. W. MIDGLEY, F.R.Met. S.

Met. Observatory, Bolton, August 15th, 1888.

As showing the lateness of the season, it is noteworthy that in Prince's Park, Liverpool, there were to be seen late in last month several hawthorn trees in bloom, more especially the pink blossom variety.

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Reviews.

Transactions of the Isle of Man Natural History and Antiquarian Society. [Vol. 1, 1879—84.]

ALTHOUGH this Society has been established for upwards of nine years, the papers read have not been published in volume form. The Society has had, it is true, the advantage of full reports of their proceedings in the Manx press, but papers of the character indicated in this volume should be preserved in a form where reference to them can be more readily made than in the columns of a newspaper. The Publication Committee have, we think, wisely determined upon reprinting, with but few and unimportant omissions, the addresses, reports, lists and papers which have been contributed to their Society during a period almost covering its first decade. This action has already met with so great a measure of success that arrangements are being made for the issue of a second volume, bringing the Society's "Transactions" down to date. The papers now printed cover a wide range of subjects, and show that there exists in the Isle of Man not only a vast field of work for the scientific explorer, but able hands to carry out scientific investigations. Botany, Geology, Biology, and Archæology are all represented in its pages, and the several lists which are given of the birds, ferns, algæ, mollusca, and minerals of the Island will be invaluable for reference by all who wish to acquaint themselves with the natural history of the Isle of Man. It is not an easy task to particularize any special contribution amongst the many useful papers when there is so much that is good, and a list of the principal contents will sufficiently show the character of the work so effectually done in the Island:—"The Primitive Period," by T. Grindley; "Ægeria Philanthiformis," by E. Birchall, F.L.S.; List of Birds, by P. M. C. Kermode; of Ferns, by Miss Crellin; of Mollusca and Algæ, by Rev. T. Talbot; of Fish, by J. C. Crellin; of Mosses, by G. A. Holt, F.B.S.E.; and of the Minerals of the Island, by Warrington W. Smyth, F.R.S.; "Antiquities of Ballaugh," by Rev. W. Kermode; "The Causes of Winds and Storms," by A. W. Moore, M.A.; "Preservation of Manx Names," by Rev. E. B. Savage; "Flints and Flakes," by F. Swinnerton; and "Note on a Sepulchral Urn found at Port-e-Chee," by A. W. Moore, M.A.

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Transactions of the Manchester Geological Society. [Part xx. Vol. xix. June, 1888.]

THIS number is of exceptional interest, and contains several good papers of practical worth. The paper by Mr. W. J. Bird on the South Durham Salt Bed will attract attention just now, when new salt borings are contemplated in the vicinity of Warrington. Mr. W. Watts discusses the distribution of boulder clay and associated erratics on the lower portions of the drainage areas of the Oldham Corporation Waterworks. The highest boulder was found at an altitude of 1,050 feet, on the hill overlooking Hollingworth Lake. An interesting "find" of small flint implements beneath peat at March Hill, between Huddersfield and Oldham, is described by Messrs. R. Law and J. Horsfall. Details are also given in this issue of the sections of strata recently disclosed in sewage operations along Oxford Street, Manchester. In one of these cuttings, it will be remembered, was found the "giant boulder," now in the quadrangle of Owens College.

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Chester Society of Natural Science. 17th Annual Report for the year 1887-8.

THE report of this flourishing society (founded by the late Charles Kingsley) is always an interesting *resumé* of active work, and this year it is no exception to the rule. Few local societies in the kingdom manage to show a record of such unvarying success in stimulating the energies of so wide a *clientele* of members. The whole range of natural science falls within the scope of this society, and a new section devoted to photographic interests has lately been added. The work is divided into six sections, five of which met during the session, the attendances being, it is stated, larger than for several years past.

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Nottingham Naturalists' Society. Transactions and 35th Annual Report, 1887.

THIS enterprising society now numbers 175 members. During the past year 13 evening meetings have been held. Ripon and Fountains was the scene of the annual excursion. The following papers are printed in full in this number:—"Glaciers," by E. J. Bedford; "Spontaneous Generation," by E. Kidson; "Smell and Taste," by W. J. Abel, F.R.M.S.; and "Notes on the Flora of North Notts.," by the Rev. H. Friend, F.L.S. The paper on "Glaciers" is an especially good *resumé* of the subject, and the author adduces some striking instances anent glacial action in the valleys of Wales.

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Manchester Microscopical Society. Transactions and Report, 1887.

AN excellent "ink-photo" of Dr. John Tatham, B.A., late President of the Society, forms the frontispiece to the present volume, which contains several well-written papers on subjects of general interest, besides reports of the society's excursions. Professor Herdman's lecture on "Ascidians" is given, illustrated with two plates. Other contents of this number include "The Recapitulation Theory," by Professor Milnes Marshall (President); "Explosion of Paraffin Lamps;" "Mosses and Hepaties;" "Schwendener's Theory of Lichens;" "Saccharine;" "Pliocene Fossil Polyzoa;" "Natural History of Oceanic Islands," &c., many of them being illustrated.

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Proceedings of the Liverpool Geological Society, 1887-8. [Vol. v. Part iv. Edited by W. Hewitt, B.Sc.]

A volume more bulky than usual records the work of this old-established society during the last session. Its contents are of particular interest, and we regret that space does not permit us to do more than mention a few of the titles of papers printed in this part:—"Local Geology," by G. H. Morton, F.G.S. (President's Address); "A Theory to account for the Airless and Waterless Condition of the Moon," by Rev. F. F. Grensted, M.A.; "Geology of St. David's," by T. Mellard Reade, C.E.; "Preston Dock Works," by E. Dickson; "On the Coloring Matter of the Mineral 'Blue John,'" by A. Norman Tate, F.I.C.; and "Joints in the Keuper Sandstone," by H. C. Beasley.

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Fifty Years of Economic Botany. [Being the Royal Botanical Society of London Jubilee Prize Essay. By J. W. Ellis, L.R.C.P.]

Dr. Ellis in this treatise has achieved a task upon which he may well be congratulated. The period embraced within the reign of Her Majesty Queen Victoria marks (as our author states) an era in the progress of British manufactures without parallel in any place or age, and in contributing to the welfare of the British people economic botany is found to have played an important part. The "essay," which gives an excellent summary of the various substances derived from the vegetable kingdom which have either been newly introduced, or for which new and important commercial sources of supply have been opened, is divided into eight chapters, treating of Textile Materials, Paper, Guncotton and its Derivatives, Dyeing and Tanning Materials, Gutta-percha, Vegetable Oils and Fats, Foods and Beverages, and Timber. Each of these subjects is dealt with in a thoroughly practical manner, and so much useful information is brought together in a small compass that few, we should imagine, would read the author's pages without deriving some fresh facts from their perusal.

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"The World's Workers" (London, Cassell & Co.)

OF this excellent series of interesting biographies two volumes appear to us to be especially worth notice in connection with scientific literature, viz.:—"*George and Robert Stevenson*," by C. L. Marteaux, and "*Thomas A. Edison and Samuel F. B. Morse*," by Van Buren Denslow, LL.D., and Jane Marsh Parker. Written in a pleasant, entertaining style they show clearly the circumstances attending the scientific studies of these eminently practical men, and the manner of their progress towards useful results. Such books cannot fail to incite to the study of science, and the use of scientific knowledge in practical directions. In connection with the rapid development of the telegraph, the telephone, and the electric light, and the probable early extensive use of the phonograph, the biographies of Edison and Morse are especially interesting.

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We have received the *Journal of the Liverpool Astronomical Society* for August, 1888, forming the first number of a new volume, under the editorship of Mr. J. H. Isaacs. The *Journal* aims at something more than merely recording the proceedings of the successful society the name of which it bears. Notes of general information are given, with the view of making it a useful medium between all who appreciate or are interested in the study of astronomy. A "Popular History of Astronomy," by the editor, is announced for publication in the forthcoming number.

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Chester Societies is the title of a useful publication designed specially to contain the notices of the various scientific and other societies which meet in Chester, and to present other local matter of popular interest. Two articles in the present issue (August) deserve special mention, "Nature's Kindergarten," insisting upon the development of faculties of observation mongst students of science, and "Trespassers will be prosecuted," referring to the existing state of the law as regards public "right of way" over foot-paths leading to walks and places pleasant to naturalists and others.

New and Forthcoming Works on Science.

A WORK which promises to be a valuable addition to zoological literature is announced to be shortly published, entitled "*A vertebrate fauna of the Outer Hebrides*," by J. A. Harvie-Brown, F.R.S.E., F.Z.S., and T. E. Buckley, B.A., F.Z.S. It will form a small 4to volume, illustrated with maps and plates, and the subscription price is one guinea. A chapter on the geological features of the district will be contributed by Professor Heddle.

"*Geology for All*" is the title of a new attempt to popularize the science of Geology. It is written by J. Logan Lobley, F.G.S., in a lucid and very interesting style, well calculated not only to attract general readers, but to give clear and accurate instruction to geological students; and is published in London by Roper and Drowley. Price 2/6.

THE same publishers are about to issue "*Planetary and Stellar Studies*," by J. Ellard Gore, F.R.A.S., Mem. Liverpool Astron. Soc., a series of short papers on the planets, stars, and nebulæ. Price 7/6.

MR. PHILIP M. C. KERMODE (author of the useful "Catalogue of the Manx Crosses," &c.,) has in preparation a work on Ramsey and the North of the Isle of Man, giving full notes on the historical, antiquarian and scientific features of the northern half of the island, including lists of fossils, plants, animals, together with maps and illustrations. The same author has also in the press an elaborate memoir on the Runic Monuments of the Isle of Man, with special reference to the crosses and inscriptions, of which illustrations will be given.

MESSRS. LONGMANS & CO. have in the press *A Handbook of Cryptogamic Botany*, by A. W. Bennett, M.A., B.Sc., F.L.S., Lecturer on Botany at St. Thomas' Hospital, and George R. Milne Murray, F.L.S., Natural History Department, British Museum. The need of a really good handbook of Cryptogamic Botany of recent date has been much felt. This volume will contain numerous illustrations, and will give descriptions of all the classes and more important orders of Cryptogams, including all the most recent discoveries and observations.

THE same firm have also nearly ready *A Text-Book of Elementary Biology*, by R. J. Harvey Gibson, M.A., F.R.S.E., Lecturer on Botany, University College, Liverpool.

THEY also announce for early publication the following educational works:—*Building Construction and Drawing (Elementary)*, by Edward J. Burrell, Second Master of the People's Palace Technical Schools, London; *Theoretical Mechanics (Elementary)*, by J. Edw. Taylor, M.A. (Lond.), Head Master of the Central Science School, Sheffield; and *Elementary Physiology*, by W. S. Furneaux, F.R.G.S., Teacher of Physiology in the Pupil Teachers' Schools of the London School Board.

Societies.

THE BRITISH ASSOCIATION—The fifty-eighth annual meeting of this association will commence on Wednesday, Sept. 5th, at Bath, under the presidency of Sir Frederick J. Bramwell, D.C.L., F.R.S., M.Inst.C.E. The reception room will be opened on Monday, Sept. 3rd, at 1 p.m., and on the following days at 8 a.m. for the issue of tickets to members, associates and ladies, and for supplying lists of prices of lodgings, and other information to strangers on their arrival. No tickets will be given after 6 p.m. The first general meeting will be held on Wednesday, Sept. 5th, at 8 p.m. precisely, when Sir H. E. Roscoe, M.P., will resign the chair and Sir F. J. Bramwell, president elect, will assume the presidency and deliver an address. On Thursday evening at 8, there will be a soirée; Friday evening, 8-30, a discourse on the "Electrical Transmission of Power," by Prof. W. E. Ayrton, F.R.S.; Monday evening at 8-30, a discourse by Prof. T. G. Bonney, D Sc., &c., on "The Foundation Stones of the Earth's Crust"; Tuesday evening at 8, a soirée; and on Wednesday, Sept. 12th, the concluding general meeting will be held at 2-30 p.m. The sections will be:—A, Mathematical and Physical Science; president, Prof. G. F. Fitzgerald. B, Chemical Science; president, Prof. W. A Tilden. C, Geology; president, Prof. W. Boyd Dawkins. D, Biology; president, Mr. W. T. Thiselton-Dyer. E, Geography; president, Colonel Sir C. W. Wilson. F, Economic Science and Statistics; president, the Right. Hon. Lord Bramwell. G, Mechanical Science; president, Mr. W. H. Preece, F.R.S., M Inst. C.E. H, Anthropology; president, Lieut.-Gen. Pitt Rivers, D.C.L., &c. Excursions to places of interest in the neighbourhood of Bath will be made on Saturday, Sept. 8th, and Thursday, Sept. 13th.

INTERNATIONAL GEOLOGICAL CONGRESS.—In connection with this Congress, which, as we have already announced in our July issue, will be held in London, from September 17th to September 24th, several excursions have been arranged to take place in the week after the meeting, and will include visits to—1. The Isle of Wight (visiting the Ordnance Survey Office at Southampton on the way); 2. North Wales; 3. East Yorkshire; 4. Norfolk and Suffolk; 5. Central England (Jurassic Rocks); and 6. West Yorkshire. One of the most interesting of these will be that to North Wales. At Llangollen, Mr. G. H. Morton, F.G.S., of Liverpool, will act as Leader. The members of the Chester Society of Natural Science will also take part in this Excursion. Amongst the names of distinguished foreign geologists who have signified their intention of joining in this Excursion we notice the following: Prof. Kayser, Marburg; Prof. Von Koemar, Gottingen; Prof Szabó, Buda Pest; Dr. Barrois and Prof. Gosselet, Lille; Dr. Molengraff, Amsterdam; M. de Margerie, Paris; Dr. Credner, Leipsig; Prof. Claypole, Philadelphia; M. Delgado, Lisbon; Prof. Szajnecha, Cracow; Prof. Klockmann, Clansthal; M. Cortese, Rome; Baron Scander Lævi, Florence; Baron Von Richthofen, and Dr. Sterry Hunt.

THE BRITISH PHARMACEUTICAL CONFERENCE.—The twenty-fifth annual meeting will be held in the large room of the Grand Hotel, Bath, on Tuesday and Wednesday, September 4th and 5th, under the presidency of Mr. F. Baden Benger, F.I.C., F.C.S. The arrangements so far made include: on Monday, September 3rd, a reception by the president and other officers of the conference at the Grand Hotel at 8 p.m., to be followed by a conversazione. The next day, the opening meeting of the conference will take place, when the Mayor of the town will welcome the members. The president's address will then be delivered, and the reading of reports, and reading and discussion of papers will follow. On Wednesday, the reading of papers will be continued at the Grand Hotel from 10 a.m. to 1 p.m., and from 2 till 4 in the afternoon. Thursday, September 6th, the concluding day, will be spent in visiting the Wye Valley and other places in the district.

SEVERN VALLEY NATURALISTS' FIELD CLUB.—The place selected for the annual three days' excursion this year was Dolgelly. The first day was spent at Barmouth, where the botanists did good work under the direction of Mr. Kynoch. At Dolgelly, on the following day, the Torrent Walk was searched for rare plants, the following being amongst those found:—Wilson's filmy fern (*Hymenophyllum Wilsonii*) maidenhair spleenwort (*Asplenium trichomanes var. cristata*), and mountain speedwell (*Veronica montana*). From the Torrent Walk the party proceeded through the pass of Bwlch Llyn Bach to the Lake of Talyllyn,

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where the rugged masses of rocks afforded many opportunities of geological study. The last day was devoted to inspecting the gold mines and waterfalls of Pistyll-y-Cain and Rhaiadr Mawddach, near which are situated the buildings and crushing machinery of the Gwynfynedd Gold Mine. The party saw all they could of the crushing and washing, and afterwards visited the mine, a mile distant. Attention was devoted to examining the pieces of quartz. There was no time to enter the mine to see the gold in *situ*, but a few minute specks were pointed out near the door of one of the offices. The party returned the same way to the bridge over the Eden. The following plants were found on the route to the gold mines:—Hemp agrimony (*Eupatorium cannabium*), Bog pimpernel (*Anagallis tenella*), Ivy-leaved bell-flower (*Campanula hederacea*), Saw-wort (*Serratula tinctoria*), Bog asphodel (*Narthecium ossifragum*), Stone bramble (*Rubus Saxatilis*), Live-long stonecrop (*Sedum Telephium*), Butter-wort (*Pinguicula vulgaris*), Round-leaved sundew (*Drosera rotundifolia*), Wood-bitter vetch (*Vicia orobus*), Golden rod (*Solidago Virgaurea*). The *Mimulus luteus* was found naturalised in several places, and the Evergreen alkanet (*Anchusa sempervirens*) was found near Dolgelly. After dinner in the evening, an address was given by Dr. Callaway, F.G.S., of Wellington (the well known authority on Pre-Cambrian Rocks), in which he made an instructive comparison between the Wrekin and Cader Idris; both mountains were composed of volcanic materials, but of two epochs, one being Lower Silurian (*Ordovician*), and the other Pre-Cambrian.

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GEOLOGY IN YORKSHIRE.—There are few counties in England possessing rich fields of research more zealously investigated than the one which the geologists of Yorkshire have in their special charge. Both the Leeds Geological Association and the Yorkshire Naturalists' Union pursue their enquiries with much earnestness, and are eager to take every opportunity of gaining a further insight into the geological structure of their district, by visiting new sections of strata as they are from time to time opened out by railway enterprise or other operations. Mr. S. A. Adamson, F.G.S., of Leeds, has published exhaustive notes on the sections which have been revealed in this way, and has favoured us with copies of some of the most important records of his observations. These include the wonderfully interesting geology of the Kinderscont district, with the different Grits and Yoredales are so conspicuously developed. The carboniferous formation has also been studied in excursions to the Meanwood Valley, Calverley Wood Quarries, and the Leyburn district. The Permians were examined along the valley of the Niad, from Knaresborough to Ripley. A new railway cutting on the Skipton and Ilkley line afforded fine sections of the carboniferous limestone, where, as at Draughton, the sharp anticlinals and synclinals are so well developed. On the Beeston and Batley line further new cuttings in the coal-measures have been made, and a line which is to connect Market Weighton and Driffield has opened out some fine sections of a later formation, the chalk. We hope to refer at greater length in a future number to some of the numerous questions of deep interest raised by this wide reaching series of geological investigations.

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MANCHESTER MICROSCOPICAL SOCIETY.—During the summer months the members of this Society seem determined to utilise as much time as possible in out-of-door scientific study, supplementing, in a practical way, the work of the winter session. The arrangements for "Rambles" (a pleasanter name than the stiff "field-meeting"), include visits (which have either been already made, or are yet to come off) to Reddish Canal, Middleton, Southport, Hilbre Island, Guide Bridge, Ashley, Cotterill Clough, and Worsley. The neighbourhoods selected are known to be rich in microscopic organisms, in the collection and naming of which the leaders in each case give every assistance to members. The "Rambles" have been specially arranged with a view to promoting social intercourse, and for collecting microscopical material.

MANCHESTER CONCHOLOGICAL SOCIETY.—At the monthly meeting of this Society, it was announced that the Conchological Society of Great Britain and Ireland had accepted it as an auxiliary branch. The members of the new branch propose to investigate Lancashire, Cheshire, Derbyshire, and that portion of Yorkshire not further than twenty miles away from Manchester, so as to record the localities and habitats of the *Molluscan Fauna*, and to form a collection of the species, which will be deposited in Owens College Museum. A member exhibited some *Zonites* and *Cochlicopa* which had been perfectly cleaned by a new and easy process. Other specimens were shown by various members.

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LIVERPOOL GEOLOGICAL ASSOCIATION.—On August 6th, Bank Holiday, a field meeting was held at Holywell, conducted by Mr. R. Williams; Dr. Ricketts, F.G.S., assisting as demonstrator of Glacial Geology, and the Secretary, Mr. D. Clague, as Palæontologist and Mineralogical Referee. The work commenced soon after leaving Holywell Station, at Greenfield, which was observed to stand on an alluvial deposit; leaving Greenfield by the Strand Road, a slight elevation in the ground indicated a passage from the alluvium to a harder rock which proved to be of middle coal-measure age. Here attention was directed to the ruins of Basingwerk Abbey, interesting to the archæologist from its history, but its special interest to the geologists was in the curious and fantastic weathering of the stones of which it is built; these features were photographed by Dr. G. H. Webb and Mr. Cecil F. Webb, for future reference and study. The passage from middle to lower coal-measures, represented here by the Gwespyr sandstone and Holywell shale, was marked by a change in the slope of the hill, the latter part being steeper and more rugged, caused progress to be slower and a little more difficult, but this was fully compensated for by the beauty of the scenery. Passing over the Chert-beds, which here represent the millstone grit, we proceeded to the White Limestone Quarries, near Pant-Asaph, which were found to be rich in *Producta*, *Encrinites* and *Polyzoa*, on the way a lead mine was visited, where the material brought up by the miners was carefully examined. Dr. Ricketts, F.G.S., drew attention to the great quantity of moraine matter which forms the surface deposit over a great portion of the district, an examination of the enclosed boulders shewed many of them to be striated, and in some instances the striæ were interrupted by subsequent erosion. The fossils secured included *Productus Giganteus*, *P. Semireticulatus*, the Trilobite *Phillipsia*; amongst the *Polyzoa* were *Sulcoretopora Paralella*, *Thamniscus Rankini* and *Polypora* (?), numerous corals and encrinital stems, and a few fish spines. Amongst the mineral specimens found were Calcite of various kinds, both nail-head and dog-tooth spar, opaque and transparent, amethystine and white; Aragonite, Phtanite, Banded Chert, Blende, Calamine, Galena, Morion, and Umber.

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Letters to the Editor

POND LIFE.

SIR,—For the information of those of your readers in this locality who are interested in the microscopic study of pond life I would mention that the canal near the Chester Lunatic Asylum is very rich at present in *Rotifers* and *Polyzoa*. The social animalcule (*Lacinularia socialis*) is especially worth notice. T. S.

Chester, August, 1888.

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HARROGATE AND DINSDALE-ON-TEES.

SIR,—I have read with much interest your article on "Harrogate" in the first number of your Journal; I now beg space to draw the attention of your readers to the following. In an article which appeared in the *Lancet* for August 4th, 1888, Dr. Squire, F. R. C. S. (Physician to

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St. George, Hanover Square, Dispensary, London), states that, geologically, Dinsdale-on-Tees and Harrogate resemble one another, a line of fault being traced in the sandstone and adjacent millstone grit in each case,—"both are situated on the margins of millstone grit, one being at the northern edge of the Yorkshire coal-basin, the other at the southern end of the Durham coalfields." He is of opinion that the sulphur spring of Dinsdale-on-Tees (which is the station next south of Darlington on the Great Northern and North Eastern Railways) surpasses that of Harrogate, and is "in fact unequalled by any sulphurous water source short of the Alps." Dr. Squire further remarks that Dinsdale contains besides a chalybeate water and another mild sulphur water, a mineral spring, which has been analysed by A. W. Stokes, F.C.S., F.I.C.—the composition of the mineral matter stated in grains per gallon being: sulphate of soda, 32.9; sulphate of magnesia, 37.68; sulphate of lime, 93.0; carbonate of lime, 38.7; chloride of sodium, 9.0; silica, 0.56; oxide of iron and alumina, 0.42: whilst the organic matters yield nitrogen, present as nitrates, 0.28; nitrites, none; ammonia, 0.0014; albuminoid ammonia, 0.0098; the amount of oxygen absorbed in 15 minutes to oxidise the organic matter was 0.019 gr., or in three hours, 0.028. Dr. Squire adds, "this is a sample of an undoubted and valuable mineral water entirely free from pollution," and concludes his very interesting article thus:—"The sheltered position of Dinsdale offers advantages for such trial; the facilities for frequent change of air to such healthy and exhilarating places as Redcar, Saltburn, Whitby, and Scarborough, with temporary sojourn in the keener climate of Harrogate, would enable young invalids, during all the early summer, autumn, and winter, to make Dinsdale their headquarters, and the scenery of the Tees, with the great Yorkshire valley and the distant views of the Cleveland Hills, as seen from its northern cliffs, a constant pleasure either to look upon or to remember."

Hull, August 11th, 1888. H. A. A.

Examination in Botany.

Sir,—I shall be pleased to know from any of your readers who may be teachers of botany with what success their students passed the recent examination of the Science and Art Department. Twenty-four of my students presented themselves for examination, and not one obtained a 1st Class. Several of them were, in my opinion, fully qualified to obtain such a position, and I make this statement after having taught botany for over eight years with a considerable amount of success. As might be supposed, after having worked hard and conscientiously during the whole session, they were much dissatisfied with the results. From the past reports of the Examiners it appears that great importance is attached to a knowledge of physiology and the power of accurate description. Now, to both of these points I gave much attention, and my teaching was fully illustrated both by fresh specimens and by microscopic preparations. Under these circumstances I cannot help thinking that the number of marks required to obtain a 1st Class has been unreasonably increased, a proceeding which cannot fail to dishearten both students and teachers. It may be, however, that there was something wrong in my method of instruction, and that other teachers of botany can report more favourable results. UMBEL.

Science Teaching.

Sir,—The following advertisement appears in a scientific journal:—"(1) What is the best text-book for the elementary stage of magnetism and electricity? (2) What is the best book on the same subject for a teacher who passed in the advanced stage, *but never saw any experiments performed*, and who now wishes to teach the subject for the Science Department, and perform the experiments required to illustrate the teaching in the elementary stage?"

In teaching science it is surely of the highest importance that those who undertake to instruct should, in addition to possessing the necessary capabilities for their work, have a thorough and practical knowledge of the subject; and it seems to me that it is the half-knowledge implied in the admission in the above quotation which is responsible for much of the inaccurate work often done by students in this subject, who can hardly be expected to master details of which the teacher is himself professedly ignorant. LYNX.

Lycœnia Argiolus at Lucerne.

Sir,—During a recent visit to Lucerne, at the end of July and beginning of August, I saw a very large number of this butterfly in the *marshes* in the neighbourhood of this much-frequented lake. Can any of your readers inform me what plant could possibly form the pabulum of this species in the situation mentioned?

Ladywood, Birmingham. W. HARCOURT BATH.

Science and Art Department Examinations– Mechanical Subjects.

Sir,—A large amount of dissatisfaction has, for some years, been expressed regarding the range of questions set in some of the examination papers of the Science and Art Department, and more particularly in the case of the mechanical subjects. The Examiners have, in some instances, stepped outside the actual range of their subjects and inserted questions which cannot be accepted as a test of the student's knowledge, and the practical utility of which may be questioned. As the instruction and examination in the mechanical subjects are nothing if not of a practical nature, both should be so arranged that the first may consist of imparting the greatest amount of *useful* knowledge of the subject, and the second a fair test of that knowledge, no superfluous matter being introduced to the neglect of the more important principles and their application. If a student joins a class, his object in doing so is, in ninety-nine cases out of every hundred, that he may gain a knowledge of certain principles, so that in time he may be able to apply them to the work in which he is engaged, and the examination is supposed to be a test of his proficiency to do so.

Let us look at the examination papers in two popular mechanical subjects and see what an Examiner can do, by the exercise of a little judgment, towards making his examination a real test.

Take first the Applied Mechanics Examination Paper for this year. Now one would imagine that a paper in this subject would be almost wholly composed of questions having a direct bearing upon the composition of structures and the nature of the strains to which structures generally are subjected; the instruction in the subject being in accordance therewith. It is a well-known fact that a very large percentage of the students who enter classes for Applied Mechanics are youths serving their apprenticeship to some branch of Engineering, and they naturally look to being taught what may be termed Applied Mechanics proper. The disappointment is, therefore, keen when it is found that a large portion of the session has to be taken up with the study of mechanism and its geometry and laboured explanations of the construction of clocks and watches. It may safely be said that during this portion of the session the attendance, as a rule, drops fifty per cent., it being only with the greatest possible trouble that a few students are induced to take even a passing interest in it.

Taking the elementary stage of the examination paper first, we should take exception to such questions as 4, 7 and 9, as outside of the subject proper, and suggest the introduction, instead, of questions of more direct practical utility, similar, for instance to numbers 2 and 10, the first of which illustrates a useful principle, and the second dealing with the strength of a beam in a practical manner. It is also desirable that the introduction of too many purely descriptive questions should be discouraged.

In the advanced stage we have numbers 22 and 27, which are

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questions on the geometry of mechanism, and two or three others of a purely descriptive nature.

It is with the honours stage of the paper that the greatest amount of fault is to be found. For instance, there is only one question which may be said to have a direct practical bearing; *viz*, that marked 44, and it is a really good representative one, the understanding of the underlying principles upon which its solution depends being of great assistance to the engineer and others connected with structures. If out of the seven questions set there were five of the same practical value as number 44, and the remaining two of a descriptive nature, but still bearing on applied mechanics proper, we do not think any fault could have been found with this stage of the examination, but the others are for the most part simply questions on mechanism and its geometry, the majority evidently unsuitable for an examination in applied mechanics, and certainly not a fair test of the student's knowledge of the subject for which he is sitting. It would have been quite possible, this year, for a student, with a knowledge of mechanism only, to have gained a first class in the honours stage of applied mechanics, the same student being, most likely, unable to determine the strains on or calculate the dimensions of the principal parts of a simple 5-ton crane, and this, when looked at from a practical point of view, is nothing short of absurd, and should be made impossible.

The other day, one of the leading engineering papers remarked, in reference to the examination paper in applied mechanics, that if all the managers and head draughtsmen of all our leading engineering works had gone straight from the works and sat for the honours stage of this examination, not more than fifty per cent. would have passed, and not more than ten per cent. would have gained a first class; but we think even this over stated, and, from an extensive experience, would place the percentage of passes at twenty-five, and of first classes at five.

It is not intended here to under estimate the value of "mechanism" as a subject, but to urge the necessity of keeping the subject "applied mechanics" within reasonable limits; also, that the practical, and therefore the most useful element shall be kept distinctly in the foreground, and in saying this we are simply giving expression to the views of all practical men, and certainly all teachers of the subject who have anything to do with the practical application of mechanics.

Let us now turn to the "Machine Construction and Drawing" examination paper, and here a more congenial task awaits us, for it is really a model one. Taking the three stages into which the examination is divided, there is not a question that any practical man could find fault with, and the examination is kept within the limits of the subject. It is divided into two parts, one being to draw certain examples of pieces of machinery to scale, and the other to answer several general questions, which are intended to test the students' knowledge generally. The examples to be drawn are roughly sketched, and portions left unfinished, so that we have even here a double test, viz., that of drawing to scale, and also of the students' ability to fill in parts left incomplete. Anyone looking down the list of general questions from *a* to *f* in the elementary, and *g* to *n* in the advanced stage, could not help but be struck with the care the examiner has exercised, that his examination shall be a fair test of the students' knowledge of the subject; and the same may be said of the questions in the honours stages.

We need not point out the satisfaction a paper of this description gives to the teacher. He knows that the whole of the session may be employed in imparting knowledge which will be of every day use to the student, and that the examination will be a fair test of such knowledge. In this paper it is an easy matter to recognise the hand of one who has had a practical training, and in our opinion the mechanical subjects would be taught to a more useful end, and the examination be accepted as a fairer test, if all the examiners in these subjects were practical men, that is, men used to the application of principles to actual work.

S

Jottings.

THE committee of the new Bingley Technical School have now taken the work in hand, and the contracts have been let. The work will commence shortly.

THE ASTRONOMER ROYAL FOR SCOTLAND.—Mr. C. Piazzi Smyth, after holding this office, and that of Professor of Practical Astronomy in Edinburgh for forty-three years, has resigned; and, in doing so, states as a reason not only advancing years, but that he "despairs of ever being able to do anything good, or compete with other observatories, when the Government continues to refuse to do what their own Commission recommended."

THE Corporation of Sheffield intend to promote a Bill in the next session of Parliament for additional local powers, and at their meeting in August they decided, on the recommendation of the Library and Museum Committee, to include therein authority to levy an additional rate of one penny in the pound for the purposes of the Libraries and Museum. The present penny library rate yields in Sheffield about £4,500 per annum, and out of that sum are maintained five libraries and a museum, so that additional income is evidently required if those institutions are to progress and be maintained efficiently, and it is to be hoped that the additional penny asked for will be granted by Parliament.

THE YORKSHIRE COLLEGE.—APPOINTMENT OF PROFESSOR OF MATHEMATICS.—At a meeting of the council of the Yorkshire College, Mr. Leonard J. Rogers, M.A., B.Mus. Oxon., was elected to the Professorship of Mathematics, rendered vacant by the removal of Professor Green to Oxford. Mr. Rogers is also a member of the Association of Combined Lecturers, and has been since the beginning of the year delivering a course of lectures in Oxford on higher pure mathematics, in preparation for the final honour examination. For three years he has acted as an examiner for the delegacy of Oxford Local Examinations, and also for the Oxford and Cambridge Joint Board. Recently he was appointed by the University to examine in the first public examination for honours. Mr. Rogers has also been engaged in original research, and has read several papers before the London Mathematical Society, which have been published in the journals of that society.

SACCHARIN.—This new substitute for sugar has recently been the subject of investigation by a specially-appointed Committee of Hygiene of the Department de la Seine, Paris. Their report (which is referred to at some length in the *Journal de l'Epicerie*) gives some interesting details on the question whether saccharin may be introduced as an alimentary substance without danger to health. Dr. Dujardin-Beaumitz confirms the marked advantages of this substance in the treatment of diabeties, and shows that saccharin retards the action of the gastric juice upon albumenoids, whilst possessing superior qualities to boracic acid as a "microbicide." Contrary to what has been previously stated, the result of practical tests seems to show that actual digestive troubles may sometimes arise from the prolonged use of saccharin, and the Committee consider that the use of this substance should be purely as a medicament, and that its employment as an alimentary substance should be absolutely interdicted. The antiseptic properties of saccharin will always commend its use for certain medical and other purposes.

Answers to Correspondents.

INQUIRER.—(1) We cannot learn that the character of crystals has been found to be affected by the circumstances you mention, but it is not improbable, and is worth investigation. (2) The subject of your second question will be dealt with fully in this journal before long.

ONE ANXIOUS TO KNOW.—Bisulphite of lime and bisulphite of magnesia are both used for the purpose you mention. Sulphuric acid would be quite unsuitable,

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Research:

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NOTE.—Owing to the pressure upon our space, we have been obliged to hold over several articles until next month. Amongst these are:—"Local Museums," No. 4 (Bristol); "Colour Blindness;" "Phonetics;" and "Lacewing Flies."

NOTICES.

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E. W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & CO. Price 3d., or by post, 4d. Annual Subscriptions 3s., or by post, 4s.

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Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

On Science Teaching in Schools and Colleges.

PROFESSOR TILDEN, in discoursing on the teaching of chemistry in his presidential address to the Chemical Section of the British Association, said much that may well be considered in connection with Science Teaching generally. He stated that, notwithstanding that the means of instruction in Science in England have of late years multiplied enormously, "it is, nevertheless, true that increased opportunities for study, a considerable supply of capable teachers, and an enormous body of students have not produced such an amount of original investigation, or even of accurate analytical work as might be reasonably expected;" and he went on to say that he thought "the apparent inactivity of the chemical schools in this country is not generally the fault of the professors, but is chargeable in the main to the ignorance and partly to the indifference of the public."

That there is still much indifference on the part of the public in regard to Science Teaching cannot be gainsaid, and this extends even to persons who might be expected from their connection with manufacturing and industrial and commercial pursuits to fully appreciate the advantages of scientific education. But we believe that much of this is due to a cause that Professor Tilden does not mention.

We know there are many capable teachers and numerous opportunities for study, but, taking it as a whole, the teaching given is too often wanting in that which can make the knowledge imparted really serviceable in the occupations and business of daily life. Students are not sufficiently trained in habits and methods of using their knowledge for practical purposes, and the consequence is that a very large proportion of those who have gone through the usual school and college courses in chemistry and other sciences are failures from a practical point of view, and as long as this is the case the public is likely to remain indifferent.

And this is partly due to the fact that far too many of the teachers know but little of the sciences they engage to teach beyond what they themselves have learnt in schools and colleges; they have had too little opportunity of facing the problems met with in applying science to practical pursuits, and of having their wits sharpened by the constantly-recurring difficulties that present themselves, and which require, in order to be surmounted, not only a knowledge of

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scientific facts and theories, but a ready appreciation of the value of these in dealing with any special circumstances that may occur. To teach science properly, it is necessary to have lived in the facts that are spoken of in a teacher's lectures, or worked out in the ordinary laboratory courses.

Many of the governing bodies of colleges pay more attention to school and university distinctions in selecting their professors and teachers than in searching for men capable of giving practical bent to the knowledge imparted.

Then, again—and to this Professor Tilden did refer—in most of our colleges our professors of Science are sadly over-burdened, as when "one man is called upon to discharge the duty of teaching classes, both elementary and advanced, in pure and applied chemistry, inorganic and organic, theoretical and practical." Under such a system a professor has no time or opportunity to keep himself apace with the progress of knowledge, test statements he finds in text books and current scientific literature, work out carefully methods of teaching, and engage in original research, which latter is a discipline of immense value to a teacher. The teacher must ever be a learner, and he must have time to learn. And another result of the overburdening of professors is that much of the tutorial work and laboratory manipulation is in reality, if not in name, too often under the superintendence of young men, acting as demonstrators, who, as regards knowledge, are not far in advance of those they teach, and who have not been carefully trained to teach.

And whilst this is true of many of our scientific colleges and higher schools, the same over-burdening of teachers, and the employment of insufficiently trained assistants, is still more noticeable in the science instruction given in our ordinary schools, indeed, the so-called science teaching afforded in very many of such schools is a miserable sham, given only for the purpose of passing examinations, which themselves are but tests of retention of memory and capacity to cram, and no guide whatever in assessing the power of a student to put the knowledge gained to useful purposes.

We believe, with Dr. Tilden, that examinations are necessary from time to time to test a student's progress, but we are extremely glad to notice his statement that "serious mischief begins when they are regarded as the end itself, and not as mere incidents in the student's career towards the end, which should be knowledge." We would add "and knowledge that can be put to good useful service." The examination system of this country requires a most thorough overhauling and re-modelling, and in no subjects more so than in science. At present it is, to a great extent, a curse and hindrance to true scientific progress.

There is yet another point which Professor Tilden dealt with in speaking of chemistry that requires emphasising at the present time in connection with Science study. He says —"It has always been thought essential that a student of chemistry should have some knowledge of physics. It is now more than ever necessary that this knowledge should be extensive, sound, and based upon a good foundation of mathematics. . . . . It is now asserted that a young chemist who expects to find a career in industrial chemistry should also have learnt drawing, and, more important still, that he should have a good general knowledge of mechanics, steam, and building construction." And adds—"I suppose every one will agree in adding French and German." We most cordially agree with him, as also in his suggestion for a longer period of study. And what is necessary in chemical study is equally required in the study of all science, viz., a knowledge of collateral subjects and power to bring it to bear upon the main subject studied.

In short, there is now in science teaching in our schools and colleges too great a dearth of teachers who know their subjects in all their aspects, and who have had the requisite experience to teach them thoroughly and make their students *know* them; there is too much importance placed on examinations which are grievously faulty; and there is altogether a want of thoroughness and completeness in the instruction given. Remove these drawbacks and the ignorance and indifference of the public in regard to science teaching will soon disappear, and the progress of science itself will be materially assisted.

The British Association.

Meeting at Bath.

THE annual meeting of the British Association opened this year on 5th September, at Bath. The attendance was very much smaller than at the Manchester meeting in 1887, and it is also questionable if the results generally reached the same high standard of excellence manifested in the congress under the presidency of Sir Henry E. Roscoe. For the Manchester meeting 3,833 tickets were issued to Members and Associates; at Bath the number of tickets issued only reached 1,984, being 818 less than registered at the former Bath meeting twenty-four years ago. The receipts this year amounted to £2,107. Grants to the amount of £1,645 have been allotted for the furtherance of scientific researches. Although the number of visitors was thus smaller than usual, it was sufficiently large for the accommodation provided. The reception room was of limited size and wanting in many of the conveniences to which members of the Association have been accustomed at former meetings. Some dissatisfaction was felt at the accommodation devoted to some of the Sections, which were scattered over the city at considerable distances from each other, entailing a great loss of time and strength upon visitors who wished to see and hear what was going on in the different section-rooms. The Drill Hall, in which the Presidential Address and Evening Discourses were given, was situated in the vicinity of the railway, where the noise of trains and blowing of engine whistles interfered with the comfort of the audience. From the tone of the Presidential and Sectional Addresses it became evident that at this meeting popular science would win the day, and this was verified by the subsequent proceedings. It is to be hoped that in future the executive will give greater attention to the number and class of papers accepted for reading. The large number of communications caused the daily programmes to be far too long, and even the enforced division of labour into sub-sections, which

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became necessary, did little to relieve the crush of matter. As a consequence, many valuable papers were passed over without adequate discussion, or even without their chief points being properly noted. Several of the discussions—such as those on volcanic theories, on coral reefs, and on lightning conductors—of which much had been expected, resulted in disappointment, inasmuch as no new facts were adduced by the supporters of either side, and the problems attacked were not brought appreciably nearer a solution than before. Of course, those who were previously unacquainted with the facts doubtless derived a considerable amount of information; but the lengthy discussions, in which most of the speakers were more desirous of airing pet theories of their own than of replying to the statements of their opponents, were scarcely calculated to enable an unprejudiced listener to arrive at a conclusion or to evolve order from the chaos of conflicting thoughts. Each year the "popular" aspect of the British Association seems to develope in a greater degree, and, as a consequence, some of those who took part in its meetings in bygone days are feeling anxious as to its future. The Association is in this difficulty:—If it does not appeal to the general public by popularizing science for the benefit of the intelligent, though not necessarily specialistic, community, it will lose that support which alone enables its avowed objects to be carried out. A diminished income would not admit of the committee placing at the disposal of scientific experts and selected institutions those monetary grants for the advancement of special branches of scientific inquiry which, after all, being conducted with little ostentation and rarely coming into public notice, form the most valuable and indispensable portion of the Association's endeavours to advance science. Many of these committees, subsidized by the Association, do more in the course of a year towards prosecuting actual scientific research than is effected by half the learned societies and institutions in the country. In these cases, as in all others, properly systematized labour, controlled by capable minds, forms the secret of success.

Having reviewed the general characteristics of the meeting, we proceed to glance at the chief items of interest in the proceedings.

Addresses of Presidents.

No greater contrast could be afforded than that between the addresses of Sir Frederick Bramwell and the late Sir Charles Lyell, the latter of whom, in 1864, presided over a meeting of the Association in the same city. Lyell represented pure theoretical science, Bramwell upheld modern utilitarian views. Sir Frederick Bramwell occupied himself exclusively with the applications of science which form the outcome of modern engineering. He indulged, it is true, in a little of that species of prediction for which scientists are famous, when he re-affirmed his opinion that in fifty years' time steam engines will have been abandoned in favour of some other utilisation of power. But the greater part of his address was concerned with an enumeration of the improvements and results obtained by a zealous regard for small details, aptly termed the "next to nothing."

Professor FitzGerald discoursed before the Mathematical and Physical Section upon vibrations of light and electro-magnetic action. Professor Tilden reviewed, in his address to Section B. (Chemistry), the modern state of chemical teaching and training, in which the disadvantages of trusting too much to the examination system were strongly insisted upon. The address to the Geological Section by Professor Boyd Dawkins dealt with a general survey of the science in the light of recent discoveries. Mr. W. D. Thistleton Dyer gave what was, perhaps, the most scientific address of the series, and dwelt upon the needs for a more intelligent study of Physiological Botany. The Geographical address by Sir C. W. Wilson covered a wide range, and alluded to the labours of explorers in Central Asia, Siberia, and Africa. The address of Lord Bramwell to Section F was concerned with topics of economic and statistical science, into which it is hardly our province to enter, inasmuch as the line between science and politics—if one exist—was overstepped more than once in the course of the address. Mr. W. H. Preece brought before his hearers in the Mechanical Science Section some interesting and valuable observations bearing upon electrical mechanics. One of the most deeply-interesting addresses was that of General Pitt-Rivers to the Anthropological Section. The President referred to the necessity of some reform in museum management and arrangement, and showed that a knowledge of the arts of life, as exemplified in the relics of past races, should precede a study of social evolution in order to make allowance for missing links, and to avoid the supposition of laws and tendencies which have no existence in reality.

Sectional Business.

Section A. *Mathematics and Physics.*—The papers read in this Section were mostly of a technical nature. Among the most important were by Mr. A. E. H. Love on the "Genesis of the Moon;" J. Brown on "Figures Produced by Electric Action on Dry Plates;" "The Measurement of Electric Wave Lengths," by Prof. Oliver Lodge; "Theories of Cosmogony," by Prof. G. H. Darwin; "On the Temperature of some Scottish Rivers," by Dr. H. R. Mill. Several papers on Electricity were read by Sir W. Thomson, Profs. FitzGerald, Dewar, Ayrton, &c. A joint discussion with Section G took place upon the subject of lightning conductors, which was opened by Mr. W. H. Preece and Prof. O. J. Lodge. Prof. H. S. Hele Shaw, of Liverpool, described a new sphere Planimeter. Reports of Committees on Electrolysis, Tidal and Magnetic Observations, Theory of Numbers, &c., were read.

Section B. *Chemistry.*—Prof. Sterry Hunt read an instructive paper on "The Study of Mineralogy." A discussion on "Chemical Problems Presented by Living Bodies" was opened by Prof. Michael Foster; another on "Chemistry as a School Subject" followed upon some excellent observations of the Rev. A. Irving; and a third on "Valency" was contributed by Prof. Armstrong, Prof. Williamson, and others. Mr. F. Bale gave an account of the recovery of Ammonia and Chlorine in the Ammonia-Soda Process, and Prof. Reynolds described some new Silicon and Thiocarbamide compound. The "Action of Light on Water Colours" was the subject of a communication from Dr. A. Richardson, in which he condemned as unsafe those pigments which fade in dry air, and showed that the greater number of paints are stable in sunlight, provided moisture is absent.

Section C. *Geology.*—Most of the papers in this Section were of local interest, and but few dealt with general questions. The Bath Oolite naturally came in for a full share of attention, Mr. W. Whitaker, F.R.S., describing an extension of this formation under London, as shown by a deep boring at Streatham. A very discursive discussion followed the reading of a paper by Dr. Crosskey on the "High Level Boulder Clay in the Midlands," in the course of which various views were expressed on the origin of the Drift deposits. Prof. Marsh gave a most valuable comparison of the Dinosauria of Europe and America. Mr. W. W. Watts described an igneous succession worked out by him in Shropshire, and Dr. C. Ricketts illustrated by means of a number of excellent models his theory of the probable cause of contortions of strata. Theories of volcanism were entered into by several speakers of both European and American fame, Dr. E. W. Claypole, of Philadelphia, giving an excellent paper on "Some Recent Investigations into the Condition of the Interior of the Earth." Drs. H. J. Johnston Lavis and Tempest Anderson illustrated by a vivid series of lantern photographs recent volcanic phenomena in the two Sicilies and Vesuvius. A proposal was made for the systematic photography of rock-sections and other geological features in each county. This was afterwards taken up by the Committee of Delegates from the Corresponding Societies.

Section D. *Biology.*—Papers read in this Section were full of interest, the most important being "A Lily Disease," by Professor Marshall Ward; "Heredity in Cats with an Extra Number of Toes," by E. B. Poulton; "The *Echinodermata* of the Red Sea," by Professor Jeffrey Bell; "On Adaptations for the Nutrition of Embryos," by F. W. Oliver. A large audience welcomed Sir John Lubbock's discourse on his favourite subject of "Wasps and Bees." The discussion on "Coral Reefs" (with Section C.) did not lead to any satisfactory result, though it may have placed the facts of the controversy in a clearer light. Mr. F. T. Mott (of Leicester) read a lucid and valuable Report on Provincial Museums, to which we hope later to draw attention.

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SECTION E. *Geography.*—Papers were read on the "Panama Canal," by M. de Lesseps; "Salinity of the Clyde Sea Area," by Dr. Mill; "Perspective Maps," by H. W. Clayden. Eastern topics received attention by Rev. H. G. Tomkins, Major Conder, and others; Africa, by Sir F. de Winton and others. Mr. H. J. Mackinder gave some remarks upon Geographical Terminology, which excited a considerable amount of discussion.

SECTION F. *Economic Science.*—The papers in this Section dealt with various topics of social importance, amongst which may be mentioned "Mining Royalties," by Prof. Sorley; "The Suitability of Small Towns for Factory Industries," by R. R. Tanner; "On the Statistics of Examination," by Prof. Edgeworth; "Industrial Education of Women," by E. J. Warburton; and "Agricultural Education," by Prof. James Long.

SECTION G. *Mechanical Science.*—Some of the most important work of the meeting was done in this Section. The rival merits of the phonograph and graphophone were practically illustrated to crowds of visitors during the entire session. Papers on Docks, Canals, and Water Supply attracted large audiences, and were practical in their character. Mr. S. Lloyd described a new canal lift, and Mr. L. B. Wells explained the machinery in use at the Manchester Ship Canal. Messrs. J. E. Dawson on "Gaseous Fuel," R. E. Crompton on "Electric Smelting," and F. Brain on "Electricity as Applied to Mining," contributed some valuable information.

SECTION H. *Anthropology.*—In this Section some interesting results of archæological investigations were given. Dr. E. B. Tylor related his investigations on the laws of marriage and descent. Dr. Barron described the constitutional characteristics of those who dwell in large towns, pointing out that the degeneracy of townspeople was seen more in loss of vital capacity and vital force than in loss of stature. "Tests for Colour Blindness" formed the subject of an instructive paper by Dr. Karl Grossmann. Miss Buckland drew attention to some examples of pre-historic necklaces; and Drs. Garson and Bloxam again conducted a series of anthropometric observations on all who were willing to place themselves under their tests.

DISCOURSES AND EXCURSIONS.

The evening discourses were not attended so well as usual. Professor Ayrton's, on "The Electrical Transmission of Force," was illustrated by a large display of experiments, for the most part not of a novel character. The model of Fleeming Jenkin's Telpher line was viewed with much interest. Sir John Lubbock's address on the "Customs of Savage Races" proved to be exceedingly well adapted to his audience. The rush for tickets for this lecture was very great. Professor Bonney also gave an elaborate lecture on "The Foundation Stones of the Earth's Crust."

The excursions, as might have been anticipated from the locality of the meeting, were all of high interest, and included visits to places of historica and archæological as well as geological and scientific interest. On the Saturday visits were made to Stanton Burr, Dyrham, Box Quarries, Bradford-on-Avon, Cirencester, Tytherington, Berkeley, the Severn Tunnel, Barry Dock, and Clifton; and on the following Thursday the list included Stonehenge, Avebury, Stourton, Frome, Wells, Cheddar, Wookey, Hole, and Chepstow.

The Association meets next year on 11th September, at Newcastle-on-Tyne, under the presidency of Professor W. H. Flower, F.R.S.

Leeds was selected for the meeting in 1890.

Theories of Mountain Formation.

By T. MELLARD READE, C.E., F.G.S., F.R.I.B.A.

Part II.

THE first requirements of a geological theory are that it should conform to and explain observations made in the field.

No speculations, however ingenious, are of much value in a geological sense if only deductively arrived at; hence a first requisite in the elaboration of a true theory of the origin of mountain ranges is an intimate knowledge of their geological structure.

The careful observations of eminent geologists over the accessible portions of the known world go to prove that the universal characteristic of mountain ranges is the enormous thickness of the sedimentary deposits of which they are composed.

This fact was first brought prominently forward in connection with the Appalachian chain by Prof. James Hall, of New York; and it is no less true of the Rocky Mountains, the Andes, the Alps, and the Caucasian, Himalaya, and Ural Mountains. Of these, we possess the most knowledge of the Alps and Appalachians, the combined thickness of the various formations of which they are severally composed being estimated by competent geologists at from eight to ten miles. It is a true generalisation that the necessary preliminary to mountain building is great previous sedimentation. This, as all know who are at all acquainted with the principles of geology, means the destruction of so much land elsewhere, combined usually with the accretions from volcanoes either in the form of ashes or lava streams, or both. It is also none the less evident to the student of geology that this, again, means the lapse of enormous periods of geological time.

When we come to consider in what way these various strata are arranged in mountain chains, we find, as a universal fact which there is no gainsaying, that strata which have been aqueously laid down in approximately horizontal positions are in the regions of the mountain ranges thrown into folds, and sometimes bent, contorted, and twisted into the most extraordinary convolutions.

The one opinion now held by geologists and physicists is that these effects are mainly due to lateral pressure, but, as I have already shown much difference of opinion exists as to the origin of this pressure. Not only are solid rocks folded into loops, but, as a general rule—to which there are only a few exceptions known, and these I think are more apparent than real—there is in each great range a central core composed of gneissic and granitic rocks, which often expands towards the summit, throwing the sedimentary beds through more than a right angle, producing an actual inversion of the strata, and what is called in geological parlance, "fan structure." It is rocks of this nature that at present are, and for same years past have been, the subject of much interesting study and controversy.

The age and origin of these foundation rocks are not by any means yet settled, but whether composed of metamorphosed sediments, or whether they are volcanic complexes altered and made schistose by pressure, or are partly granitic intrusions, it is evident to anyone practically familiar with dynamical principles that they have been subjected to enormous pressure deep down in the earth, and have been thereby forced up, behaving under such pressure in most respects like plastic bodies.

It will be seen from this only too short description that the characteristics of great mountain ranges are in the regions of the ranges, great foldings of the strata, semi-plastic intrusions forming the central, or what formerly was the central core of the range, often enclosing the sedimentary folds in a manner expressively likened to "button-holes," and frequently, in addition, intrusions of true granite, and trappean or igneous dyke-rocks. These folds are, excepting in the case of those buried in the earth, truncated by erosion and atmospheric influences, so that even in geologically recent ranges as much rock has apparently been removed as that which remains above the general surface level; while, in the case of older chains, such as the Urals and the Appalachians, the remaining portions are mere worn down stumps. This is the case with our Snowdonian and Cumbrian mountains, and still more is it so with the mountain fragments of the Highlands of Scotland, as irrefragably proved by the labours of our modern school of geologists, and the further fruitful labours of the survey since it cast off the meshes of the supposed succession of rocks woven and left us as an informal legacy by the late Sir Roderick Murchison.

In addition to folding there has been discovered in these North-west Highland regions an extraordinary series of lateral dislocations and reversed faults which appear to be unique, and the effect of adaption by shearing instead of folding, to changed conditions of space resulting from enormous lateral pressure.

If, however, we travel transversely from the centre of a great range, on one side if not on both, after crossing the outcrop of the strata and

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the "foot-hills," we find that the beds which in the range proper are bent and contorted into violent folds take on more gentle undulations as we recede from the mountains until they recover in the plains an almost horizontal position.

Travelling *towards* the mountains, there is usually a gentle and long ascent before we reach their base—a feature noticeable in the eastern approach to the Andes and the Rockies, and also the French approach to the Alps.

I have now, I think, said sufficient to show the intimate connection that exists between the building up or accretion of strata on the earth's crust, and their after formation into mountains.

But what are really the relations of one to the other? Are they one of cause and effect?

The upholders of the "contraction" theory recognised them as such, and met the difficulty by saying that the *locus* of accumulation is necessarily a weak place in the bosom of the earth, and therefore the earth's crust in crushing-in squeezed and folded the unconsolidated deposits instead of the hard rock existing elsewhere. This is an explanation it will be well to consider before broaching my own views on the subject. At first sight it certainly seems to possess the defect of being too neatly contrived to meet the difficulty. It assumes what is not proved; for all great areas of sedimentation must, if the hypothesis be true, be weak places in the earth's crust.

Nature, unfortunately, is not arranged on so beautifully harmonious a system; and if we on the true principles of geology inquire into what is taking place on the earth now, we have no grounds to suppose that such *selective* areas—if I may use the term—are those to which sediments are universally carried. On the contrary, there appears to be an impartial distribution of sediment dependent on a vast variety of factors, other or in addition to any that may be traced to a local weakness of the earth's crust. As I have elsewhere shown*, the North Atlantic is now receiving directly or indirectly the drainage and detritus from about twenty-one millions of square miles of land, or more than one-third the total land area of the globe. On the American or western side, on which there must now exist beneath the surface of the ocean enormous geologically recent and, so to speak, unused deposits, we have some of the most stable land on the globe, as instance the Archæan Crystalline rocks of Canada and the Brazils, while between them we have the volcanic and unstable basin of the Gulf of Mexico receiving the drainage of the Mississippi. When we consider that the earth throughout as a mass is declared by such good physicists as Sir William Thomson and George Darwin to be as solid as steel from the surface to the centre, it would seem rather foolish to search for specially weak places under sedimentary areas. If, however, it could be shown that lateral pressure consequent upon the shrinkage of the under-layers of the earth's crust, and acting only to the depth of a few miles below the surface—that is, to the level-of-no-strain—is capable of piling up the crust into mountain ranges, the explanation is a feasible one, as no doubt the upper layers of mere sediment would be weaker than the surrounding buttresses of old rocks.

The structure of all great ranges, as known through the labours of geologists the world over, negatives this supposition, and shows that we must seek for a deeper-seated force than that derivable from the secular contraction of the globe. What can this force be? It was shown long ago by Babbage, Scrope, and Herschell that the laying down of beds of sediment must produce a rise of temperature in the rocks below. Borings, well sinkings, and mining have shown that as the earth is penetrated the temperature rises, and this is true of new deposits as well as of old rocks. Many observations have been made of the rate of increase of temperature, which show that it varies to the extent of 1° Fahr. in 28·1 feet at Anzin, in the North of France, to 1° in 157·2 feet in the Minas Geraës Mines in Brazil. There is a regular but slow outflow of heat taking place from the earth, so that when a sedimentary layer or covering accumulates at any locality on the earth's surface, all the layers of that sediment eventually get heated to the normal temperature due to the depth and the conducting power of the rock.

Thus, for example, if the rate of increase is 1° in 60 feet, a deposit 6,000 feet thick would become eventually 100° hotter on the under side or base than at the surface, and all intermediate depths would take their proportionate temperature.

Planes of equal temperature in the earth's crust have been called *isogeotherms*. It is not an attractive-looking word, certainly, but the authorities having adopted it all we have to do is to follow suit, especially as the word expresses an exact thought. It will thus be seen that the laying down of sediment first affects the temperature of the immediate underlayers, but eventually it is felt to profound depths. Now what will be the effect of this rise of temperature on the portion of the earth's crust so affected? Everyone knows that heat expands and loss of heat contracts substances, but in varying degrees. To determine the amount I made a series of experiments on various rocks, and I found that the mean linear expansion was 2.77 feet per mile for every 100° Fahr. In small pieces of rock very exact and minute measurements are necessary even to detect *any* alteration of dimensions, the change of bulk being proportionately small; but when the dimensions are magnified so as to include sections of the earth's crust the change of bulk is measured by cubic miles. This, like many other things, is all a matter of *relation*, and it takes time and thought for the tyro to accustom himself to think that great effects can from little causes spring. If, however, there is one thing which geology teaches the patient investigator it is not to despise apparently small forces. We see this every day, yet we learn not. Every one-hundredth part of an inch of rain means one ton per acre. A ton seems a great deal when collected together, whereas one-hundredth of an inch seems beneath notice. So it is with the forces of expansion; by alteration of temperature they pass unnoticed until some large structure is dependent upon these forces being effectively provided for. A hot sun on one side of the Menai or Britannia tube will twist it three inches laterally and two and a-half inches vertically where it is free to move. During the very hot summer of last year the rails of many railways had to be taken up and shortened, although it is customary to allow for expansion at each joint, and the holes of the fish-plate bolts binding them together are made slightly oval to meet the difficulty. No large engineering work is properly designed unless provision is made for meeting the changes of bulk caused by changes of temperature. Metal plates for roofing, such as in lead gutters and flats, have to be laid in sections so as to be free to move, for, if soldered together in one length, they will soon tear themselves to pieces.

Notwithstanding these precautions, all old lead gutters and flats are full of wrinkles and ridges, produced by infinitesimal changes, which end in the forcing up of these ridges. Each expansion by increase of temperature bends the lead a little, while the contraction caused by decrease of temperature does not bring it back to its original form. Who has not noticed the ridges in a lead-lined bath or sink? These are due to the same cause, and are the accumulated effect of frequent minute changes caused by expansion and contraction.

But how do these familiar facts bear upon the "Origin of Mountain Ranges?" It will be my object in the next article to show this.

* *Origin of Mountain Ranges*, p. 308.

Geological Rambles.

II.—In Charnwood Forest.

GLANCING now at the igneous rocks of the Forest, the only region where true granite is found is at Mount Sorrel, on the eastern boundary of the Charnwood district overlooking the River Soar. The face of the quarries extends for nearly half a mile in length, and forms

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a prominent feature in the landscape seen from the main line of the Midland Railway near Loughborough, between Sileby and Barrow stations. The rock is a "hornblendic granite," composed of grains of quartz, felspar, hornblende, and mica, and is formed of two colours, pink and grey, due to a difference in the tint of the felspar. The mica is black (biotite). Hornblende occurs both in minute specks and in acicular crystals. The method of obtaining the stone is by excavating chambers near the summit of the hill, in which charges of gunpowder are fired. The detached blocks are then split up by small charges of powder or dynamite. Mr. G. F. Harris, in his work on *Granites and Our Granite Industries*, states that "masses of the rock are sometimes hurled by these agents to surprising distances, and instances are on record of small pieces having fallen in the village at the foot of the cliff. Great precautions are taken, however, to prevent accidents."

again in the long interval between this period and that represented by the next overlying deposit of boulder clay; the climatic conditions and geographical changes indicated during this immense lapse of time, and the vast amount of denudation involved—facts which are all brought before our minds in contemplating a section of so much interest as the one afforded by the quarry at Croft Hill. The accompanying illustration of Croft Hill Quarry (taken from a photograph) exhibits the three formations referred to. The "setts" of syenite, as quarried, are also noticeable.

Bardon Hill, in the north-west of the Forest, is an attractive centre for the geologist. Numerous excursions can be made to points of interest in the neighbourhood. The hill is of conical form, resembling the Wrekin in Shropshire. It rises 550 feet above the plain (902 feet above sea level). The ascent is made by a steep path through a thick grove of

CROFT HILL QUARRY.

From a Photograph by J. Burton & Sons, Leicester.

A—Boulder Clay. **B**—New Red Marl. **C**—Syenite.

At Cliff Hill, Markfield, Hammercliffe, and several other localities bosses of syenite appear. Although locally called "granite" the rock contains no mica, and is, therefore, not a true granite. At Markfield it is chiefly made into paving "setts." The quarrymen break the seemingly intractable stone by hand with remarkable ease into well-shaped "setts." About 10 miles to the south some isolated syenitic masses, probably connected with the Charnwood series, appear at Enderby, Sapcote, Stony Stanton, and Croft Hill. A quarry at the latter locality presents an interesting section showing boulder clay resting on Keuper marls, underlain by syenite, thus bringing the rocks of three widely separated geological periods and types into one focus for study. It would be interesting to consider here the long series of physical changes, so widely different in character, which must have intervened between the formation of these masses of syenite and the more quiet deposition of the red marl in some keuper sea or lake, and

trees which effectually prevent any prospect of the country being obtained until a rocky platform is reached near the summit, when a magnificent panorama is found to be spread beneath. At the foot the smoky chimneys of Coleorton and Ibstock indicate the vicinity of the coal measures; to the north-east rise the hills of Charnwood, and in the western distance the Welsh mountains can even be discerned. The hill is being slowly removed by an extra-natural process of denudation, two extensive quarries having been opened by Messrs. Ellis & Everard, from which quantities of the rock are excavated for purposes of road metal. The stone is brought down an incline from a higher to a lower level, and, by an ingenious self-feeding arrangement, carried direct into the machine house, where the rock falls into a cage and is broken into fragments of different sizes by powerful machinery. The assorted fragments noisily fall into a series of trucks (each truck receiving its own size of stone) which are waiting in readiness on the railway below.

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The rock at Bardon is of a very varying and puzzling character. The Survey maps erroneously mark it as "greenstone," but it has been shown from microscopical investigations that no truly igneous rock exists at Bardon. Prof. Bonney states that the hill "consists of highly-altered rock into which volcanic breccias enter largely." Although locally known as "granite" (in common with some other hard rocks of this district, which have certainly no right to the term in a geological sense), the term "felstone" is the one most applicable to it. It contains orthoclase and quartz. The rock is of a prevailing green colour, due, no doubt, to the decomposition of hornblende. Several veins of quartz run through the mass, and a bed of chloritic schist occurs near the entrance to the quarry. The pretty mineral *epidote* is found here.

A much-disputed *gneiss* is found at Brazil Wood. It is contorted, and contains garnets. This rock may be a highly-altered micaceous slate, a remnant of a still earlier Archæan formation.

The rocks of this district are thus of varied nature and interest, and several questions arise which the field geologist will bear in mind during his examination of the region. First, as to the contemporaneous origin of the ashes and slates. The fine grits are probably of volcanic origin, and these, with the coarser agglomerates (some containing large fragments of rhyolitic lava), are undoubtedly interbedded with the slates. The general strike of the beds is from N.W. to S.E. Metamorphism has altered the mud banks into clay-slate, and has given varied forms to successive flows of lava. The contortions and upheaval along the great anticlinal line of the Forest afford evidence also of great disturbances of the strata, which Professor Hull thinks took place at the close of the Carboniferous period. The fact that the lavas are of the same acidic or rhyolitic type as those of St. Davids and the Wrekin (the Charnwood lavas differing widely from those of Ordovician age) strongly supports the theory of their pre-Cambrian age; and, as has been pointed out by Professor Bonney, no truly contemporaneous lavas are known amongst undoubted Cambrian rocks.

The study of the igneous rocks offers, again, ground for diverse opinions. The syenites in some localities are well-defined rocks; in others they might be classed with felspathic porphyries. Both Mr. W. J. Harrison and Professor Bonney are confident that the syenites are intrusive, whilst the metamorphic theory is supported by Professors Green and Ramsay, the former of whom regards it as "quite certain that these crystalline rocks have not burst through the beds which surround them, but have been produced by intense alteration of the latter." No syenite is visible along the central line of upheaval. The gradations which are found between granites and quartz-felsites (see Judd's *Volcanoes*), and the other difficulties which surround questions of this nature, show that caution should be used before arriving at any conclusion respecting the igneous or metamorphic origin of these rocks.

The *Drift Deposits* of this region are of great interest, but a description of them must be left for a future occasion. Meanwhile from what has been stated it will be apparent that the working geologist who seeks for "fresh woods and pastures new" will find in Charnwood Forest a field of research which will amply reward his attention.

O. W. J.

Soap Bubbles.

By W. Hewitt, B.Sc.

To blow soap bubbles is one of the ever-fresh and engrossing pleasures of childhood. As has been pointed out, we have an unexpected testimony to this fact in the representation on an old Etruscan vase of a group of children thus engaged, while a modern recognition is to be found in those wonderful reproductions of a beautiful picture by one of our best artists, with which the latest development of the art of advertising has enriched our walls and hoardings. The precise nature of the attraction which the soap bubble has for children is not, perhaps, easy to state; but we can hardly doubt that it is due, in part at least, to the facility with which these beautiful objects may be produced with all their magnificence of colour and simple perfection of form, to the trembling vibrations of the delicate structure, and the graceful ease with which it sails noiselessly along when cast adrift.

The soap bubble is not without its attractions for children of a larger growth, and the profoundest philosophers have not been ashamed to confess themselves among its greatest admirers. From the time of Sir Isaac Newton down to the present day it has been an object of study, and has yielded many important contributions to scientific knowledge. Sir William Thomson says- "Blow a soap bubble and look at it; you may study all your life perhaps, and still learn lessons in physical science from it." In the following notes we shall endeavour to show what are some of the results which have been obtained in these studies.

A soap bubble is a liquid film, in which the cohesion between the molecules of water is increased by the addition of soap, while glycerine is also frequently added to prevent the too rapid evaporation, and so render the film more permanent. Certain effects can readily be shown by actual bubbles, but in many cases plane films—such as are formed when a ring, or the mouth of a cup or glass funnel, is dipped into the solution—are more suitable for purposes of scientific study. We shall, therefore, include these latter forms in our notice.

In blowing a bubble a certain definite amount of work has to be done in stretching the film. The air enclosed in the bubble is under pressure, as may readily be seen by putting one end of a tube in it, when the bubble will slowly contract, and in so doing force out a current of air through the tube. The film of liquid is, therefore, somewhat analagous to an elastic membrane which has been stretched, and which, in turn, exerts a pressure on the enclosed medium. The film is said to have a certain "tension," varying with the kind of liquid used and with the temperature; and this tension, which is capable of exact measurement, appears to reside only in the surface layer of liquid, and is hence spoken of as "surface tension." On account of the very large proportion of surface to mass presented by bubbles and films, these bodies are well adapted to exhibit the effects of this tension. The pressure exerted on the air enclosed in a soap bubble of one inch radius is equal to about four grains per square inch.

Sir William Thomson has based on these phenomena one of several lines of reasoning by which he has endeavoured to ascertain approximately a limit to the grained structure of matter. Knowing the surface tension, he was able to calculate the amount of work done on the mass of liquid in stretching it out into a film of given thickness. It appears that the amount of energy spent in stretching a given mass of water into a film with a thickness of 1/500,000,000 of an inch, keeping the temperature constant, would be more than sufficient, if applied in the form of heat, to convert the liquid into vapour, or, in other words, to overcome entirely the cohesive attraction between the particles. Therefore the tension, which, under ordinary circumstances, is a constant force (and in this respect unlike the tension of a stretched elastic membrane), falls off as the film approaches the dimensions stated. Sir William Thomson argues that while there is a considerable number of molecules in the thickness of the film, this decrease in the surface tension would not take place; and therefore its occurrence proves that we are attaining to a condition in which there are a very few molecules in the thickness. We have thus an approximation to the distance between the molecules. In his lectures at the Royal Institution (*Nature*, vol. xxvii., p. 278), he states, as the conclusion to which he has been led by the above and other lines of argument, that "in any ordinary liquid, transparent solid, or seemingly opaque solid, the mean distance between the centres of contiguous molecules is less than 1/5,000,000, and greater than 1/1,000,000,000 of a centimetre." [That is between 1/12,500,000 and 1/2,500,000,000 of an inch.] And he adds, "Imagine a globe of water or glass as large as a football magnified up to the size of the earth, each constituent molecule being magnified in

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the same proportion. The magnified structure would be more coarse grained than a heap of small shot, but probably less coarse grained than a heap of footballs."

The colours of the soap bubble are undoubtedly one of the main sources of its attraction. They are produced, as is well known, by the interference of two series of light waves reflected from the outer and inner surfaces respectively of the film. Newton carefully observed the development of the colours in a bubble enclosed under a glass shade, and describes how they emerged in regular order, and how at last a small round black spot appeared, which dilated to more than half an inch in breadth, when the bubble burst. This last central black spot appears when the thickness of the film is inconsiderable compared with half the wave length of the light. In the act of reflection from the second surface there is a loss of half a wave length, and therefore, when the thickness of the film becomes so small in comparison that it can be neglected, the light reflected from that surface is just half a wave length behind the light reflected from the first surface, and the result is practically total extinction.

Professors Reinhold and Rücker carried out a long series of delicate experiments with the view of determining the limiting thickness of these black films. They measured the magnitude of the electrical resistance offered by the films, and so deduced the thickness. The films were produced in enclosures in which the temperature and hygrometric condition of the air were maintained constant during the experiments. A second and quite independent method of measurement gave results so much in accordance with those obtained by the first as to justify us in placing considerable dependence upon them. In their paper, published in the *Proceedings of the Royal Society*, 1877, they state, as the result of their long series of experiments, that the mean value of the thickness of the black films is $11{\cdot}6 \times 10^{-6}$ millimetres (that is, 1/2,160,000 of an inch), while the thinnest film measured was only $7{\cdot}2 \times 10^{-6}$ mm. (1/3,500,000 of an inch). Combining this result with the calculations of Sir Wm. Thomson previously described, these same authors point out that their thinnest film would contain not less than 3 nor more than 720 molecules in the thickness.

The colours of soap bubbles and similar thin films suggest a method of measuring the wave lengths of light. If we can by any means determine the thickness of the film, and at the same time know that the traverse of the film to and fro by the light is a given fraction or multiple of the wave length, the magnitude of the latter quantity is at once obtained. The thickness of the film necessary to obtain the successive alternate bright and dark rings seen with monochromatic light was calculated by Newton, who obtained a measurable film of air by pressing together two large glass lenses of known curvature. Newton did not accept the wave theory of light, but the results of his experiment translated into the language of that theory gives for yellow light a wave length of about 1/44,000 of an inch. Knowing the velocity of light to be about 186,000 miles per second, we thus calculate that the vibrations of the ether to which light is due take place, in the case of yellow light, no less than 518 millions of millions of times in one second.

In 1878 Mr. Sedley Taylor described an instrument which he termed the phoneidoscope, which consists essentially of a frame in which a soap film showing colours is formed, and a speaking tube by means of which the air vibrations, due to a sound, are made to act upon the film. As Mr. Taylor pointed out, a film of this kind may readily be produced between the thumb and finger in the process of washing the hands, and the other hand formed into an extempore tube to direct the sound to the lower surface of the film, and many of the phenomena may thus be easily shown. The arrangement of the coloured portions of the film is varied by the pitch and quality of the sound and regular sounds give regular arrangements of colours. "The forms thus produced are of endless variety and of great beauty. They almost invariably include both motionless bands of colour, very regularly disposed, and also a system of colour vortices revolving about fixed nuclei." Such a means of investigation might be of service in the study of musical sounds, though probably other methods—such as a revolving mirror or sensitive flame—would, as a rule, be preferred. As an illustration of its use, we may instance the following. In some cases it is not easy to determine whether a given vowel sound is a true diphthong, that is, an actual combination of two distinct vowel sounds, or only a single sound represented arbitrarily by two vowel signs. When a true diphthong is slowly sounded the phoneidoscope shows two distinct figures, and thus exhibits its compound character.

In the *Philosophical Magazine* for May of this year there is a paper in which numerous interesting experiments with soap bubbles shown to the Physical Society of London by Mr. C. V. Boys, F.R.S., are described, some of them depending on the curious antipathy which one soap bubble has for another, and which prevents them, under ordinary conditions, from being brought into actual contact. In other experiments the bubbles are used to illustrate the diffusion of gases, and in others again, such principles of electricity as that an electrified body exerts no action on bodies in a closed conductor.

It would not be right to conclude a paper on soap bubbles without some reference to the labours of Professor Plateau, of Ghent. Afflicted with blindness, he was yet able, by his wonderful perseverance and ingenuity, to carry out a prolonged series of delicate and beautiful experiments on the properties of liquids, which added much to our knowledge of the molecular forces acting on matter in that condition. To him we owe the expedient of adding glycerine to the soap solution, and also that of screening a small mass of liquid from the action of gravity by placing it in a liquid of the same density with which it does not mix. The extensive treatise which he published in 1873 is a striking monument to what the human mind is capable of achieving when urged by a strong will in the face of what would at first sight seem almost insuperable difficulties.

Our Portrait Gallery.

IV.—PROFESSOR T. G. BONNEY, D.Sc, F.R.S., &c.

IN our biographical notice of Dr. Dallinger last month, we recounted some of the triumphs of microscopical investigation as applied to minute forms of life. The subject of our present sketch has applied the same instrumental facilities to the examination, not of living matter, but of the solid "foundation-stones of the earth's crust." Since the time when Sorby gave an impetus to the study of rock-sections under the microscope, there have been always a few devoted and enthusiastic workers who, disregarding for the moment problems of terrestrial geology, as indicated in the physical changes ever in progress around us, have sought for the key to the elucidation of the past history of a mass of rock by a strict scrutiny into its mineral composition, and a study of its original or modified structure as revealed by the lenses of the microscopist. Amongst these Professor BONNEY has taken a high rank. There are probably few living geologists who possess so complete a knowledge of the mineralogical and petrological characteristics of the rocks of the globe; whilst in regard to those most ancient of the older rocks—those crystalline schists of the primeval earth—of which the distinguished Professor treated so ably in his recent discourse before the British Association for the

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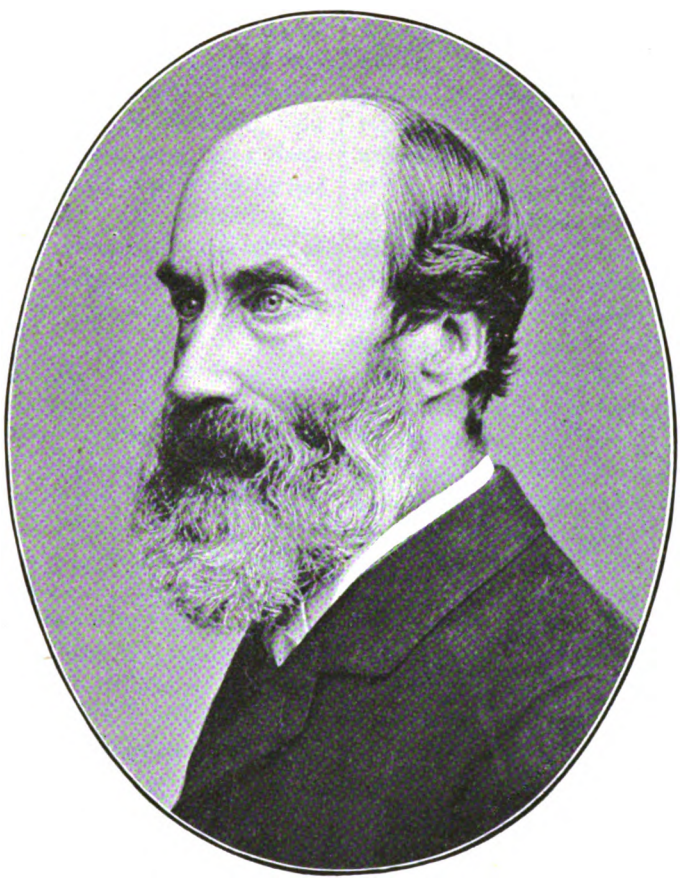

PROFESSOR T. G. BONNEY, D.Sc., LL.D., F.R.S., F.G.S., &c.

"Research" Portrait.—No. IV.—*October 1st, 1888.*

From a Photograph by H. T. Whitlock, Birmingham.

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Advancement of Science, the special studies pursued by Professor BONNEY in his investigation of the metamorphosed products of Archæan age have undoubtedly given him authority to speak as a master upon this subject. It is not too much to say that the microscope has revolutionised many of our geological teachings, and even if the old taunt that "mountains must not be looked at through microscopes" is still occasionally hurled at the petrological explorer, who is sometimes apt to trust too much to an examination of a few slices of rock under the lens, and to regard too little his colleagues' elaborate field-survey of the exposed strata, the wise student of nature will recognise the fact that without microscopical aid it is impossible to arrive at just conclusions respecting the origin of the complex structures met with in the older rocks. Professor BONNEY has always, however, insisted upon the importance of combining field work with microscopical work, and whilst acting upon these lines, some of the most valuable original work which he has accomplished has had for its object the elucidation of questions connected with the composition and structures of igneous rocks, and the nature of the metamorphism to which some of the most important rock-masses have been subjected.

The Professor has made a special study of the Serpentine and other igneous rocks of the Lizard, Ayrshire, Aberdeenshire, and Anglesey districts, and in the mountain regions of the Alps, Apennines, and Vosges. Physical Geology has also received a full share of attention at his hands. Ramsay's celebrated theory, ascribing the origin of lake-basins to excavation by glacial action, was the subject of attack in papers read to the Geological Society, in which several formidable objections to the glacial theory were adduced, and some original views offered which have been admitted to throw much light upon a difficult but always entrancing problem. In conjunction with the Rev. E. Hill, F.G.S., Professor BONNEY made in 1876-78 a survey of that interesting region in central England—Charnwood Forest—the features of which had hitherto puzzled some of the ablest geologists of the country. The results of that survey have already been alluded to in a previous article*; it will suffice now merely to say that the correct order of strata in this district has now been practically revised and laid down, and the true nature of many disputed rocks determined. More recently Professor BONNEY engaged in an investigation (not yet, we understand, entirely completed) into the physical conditions under which the Triassic strata were laid down in Britain. His conclusion that a great part of the formation included under the subdivision known as the "Bunter," instead of being deposited in lakes or seas, is of riverine origin, offers a solution to many difficulties which students of the Trias have met with. These are a few only out of many important subjects dealt with by the Professor in papers, some ninety or a hundred in number, contributed to the proceedings of the Geological, the Mineralogical, and other learned societies—written, too, for the most part, during a life which has been pretty well occupied by teaching, lecturing, examining, and other items of official work.

* "Geological Rambles," vol. i., page 27.

According to our custom, we append some brief biographical details of Professor BONNEY's career.

THOMAS GEORGE BONNEY was born at Rugeley, 27th July, 1833, educated at Uppingham, and afterwards proceeding to St. John's College, Cambridge, where he graduated as twelfth wrangler in 1856, and also obtained a second class in the Classical Tripos. He was ordained in 1857, and until 1861 he was engaged in Westminster School as Mathematical Master. Returning to Cambridge he was active in promoting several useful reforms in the University, and especially in securing for Natural Science a due place in academic studies. In 1868 he was appointed a Tutor of his College, and then he commenced a course of lectures on Geology, and in 1877 he succeeded Professor Morris in the chair of Geology at University College, London. He was appointed Secretary of the British Association in 1881, and had the main work of organising the Montreal meeting of that body in 1884, resigning the secretaryship, through pressure of other duties, in the following year. For six years he acted as Secretary to the Geological Society, and afterwards was elected President. In 1884 he was appointed Hulsean Lecturer in the University of Cambridge, and delivered a course of lectures on Science and Theology, afterwards published. Two years later he was appointed Examining Chaplain to the present Bishop of Manchester, and, in 1887, by him appointed an Honorary Canon of Manchester. Though his time is chiefly devoted to teaching and scientific work, Professor BONNEY not infrequently appears in the pulpit, and has been one of the University Preachers in the Chapel Royal, Whitehall. A member and late President of the Alpine Club, he is much addicted to mountain climbing. He is the author of a long list of well-known and valuable works, from which we have only space to extract the following titles:—"Outline Sketches in the High Alps" (1865); "The Alpine Regions" (1868); "Bernese Oberland" (1874); "Welsh Scenery" (1875); "English Lake Scenery" (1876); "Lake and Mountain Scenery of the Swiss Alps" (1874); and "Geology of Cambridgeshire" (1875). His discourse, delivered at the Bath meeting of the British Association this year, is a masterly exposition of a subject which bristles with difficulties. Referring to the "uniformitarian" views of Lyell, in this address Professor BONNEY sums up his own position thus:—"My creed also is the uniformitarian, but this does not bind me to follow a formula into a position which is untenable. Other studies with which I am familiar have warned me that a blind orthodoxy is one of the best guides to heresy."

O. W. J.

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Llandudno and its Flora.

ONE of the attractions of this thriving watering-place is its very interesting flora, and the botanical work accomplished at the meeting of the Liverpool Field Naturalists' Club held at Llandudno on August 16th may be given in illustration. Upwards of 130 plants were collected, and among them several worth special mention. Some of the plants were found on the Little Orme's Head, while the rest were gathered on the Great Orme and immediate neighbourhood. Perhaps one of the rarest was *Rubia peregrina*, or wild madder, belonging to the order Stellatæ. It is a straggling plant, trailing often over bushes and hedges for several feet, and with whorls of shining green leaves provided on the edges and midribs, with short recurved prickles, by which means it clings to other plants. The flowers are small and green, the fruit a small black two-lobed berry. This plant differs but little from *Rubia tinctoria*, which is cultivated in Southern Europe for the red dye extracted from the roots. *Spiræa filipendula*, one of the Rosaceæ, with its delicate heads of creamy pink-tipped flowers and mostly radical leaves, was found growing abundantly everywhere. This plant, which has fibrous roots, swollen here and there into oblong tubers, is next of-kin to the common meadow-sweet *(Spiræa ulmaria)*; its flowers, however, are larger and not stongly scented. The common saw wort *(Serratula tinctoria)* was fairly frequent. It is a stiff, erect plant of the Composite order, with light purple flowers in a terminal corymb, and pinnate leaves with finely, serrated edges, from which it takes its name, derived from the Latin *serrula*, a little saw. Other plants of the same order were *Inula conyza* (ploughman's spikenard), an erect biennial, its numerous dull yellow flowers forming a terminal corymb; the ovate, lanceolate leaves and other parts of the plant are covered with a short down. *Eupatorium cannabinum* (hemp-agrimony) was found on the Little Orme—a rather tall, rough plant, which bears numerous pale reddish-purple flower heads in compact corymbs. *Centaurea scabiosa* (the greater knapweed), growing from two to three feet high, and with particularly fine flowers, was most luxuriant. Its purple flowers are much larger and brighter than those of *Centaurea nigra*, to which it is nearly alllied. Another rare plant found was *Veronica spicata*, its terminal spike of clear blue flowers making it conspicuous among other flowers. It is one of the Scrophulariaceæ, to which order *Verbascum thapsus*, another of the less common plants found, belongs, and which is easily distinguished by its tall stem bearing a terminal spike of pale yellow flowers and oblong leaves; the whole plant is covered with a soft, thick, grey down. Trailing among the bushes and short herbage was *Senebiera coronopus* (wart cress), one of the Cruciferæ—a pale green glabrous annual, with slender spreading stems and pinnate leaves; the pods are sessile, or nearly so, at the base of the leaf-stalk, and are marked with deep, rough wrinkles. On the Little Orme's Head was noticed *Eryngium maritimum* (the sea-holly), at once distinguished from other plants of the order by its prickly, glabrous, bluish foliage and compact umbels of blue flowers. The roots are large, fleshy, and brittle, and are sometimes candied and form a sweetmeat. It is an umbelliferous plant, to which order also belongs *Fœniculum vulgare* (the wild fennel). This was the botanical enigma for the excursion, and was found growing fairly freely. It is hardly needful to describe this familiar plant, with its yellow flowers and strongly-scented foliage, as it is well known through being cultivated for culinary purposes. Another find was *Hyoscyamus niger* (henbane), an erect plant having viscid and hairy, soft, bluish-green foliage and handsome, cream-coloured, funnel-shaped flowers, veined with purple. The whole plant has a nauseous smell, and was formerly cultivated in Southern Europe in large quantities for its medicinal properties. Of the Labiatæ, one of the orders for competition, perhaps the most noticeable was *Origanum vulgare* (common marjoram), growing plentifully, and having very fine compact panicles of bright purple flowers and egg-shaped, downy leaves; the whole plant being fragrant and aromatic. The cultivated variety is familiar to many as a garden herb. Four specimens of the Hypericineæ were gathered, the rarest being *Hypericum montanum* (the mountain St. John's wort), an erect plant with pale yellow flowers in a compact cyme, the sepals fringed with black glandular teeth; the leaves have a row of black dots round the margins underneath, distinguishing it from others of the same order. The beautiful little *Helianthemum vulgare* (rock rose), of the order Cistaceæ, was very abundant, brightening the turf with its pale delicate yellow flowers and glabrous green leaves, more or less white underneath. The handsome horned poppy *(Glaucium luteum)* was easily detected from other poppies by its bluish glaucous foliage and pale yellow flowers, which often fall at the slightest touch when fully expanded. It bears curious cylindrical pods, growing from six to ten inches, from which it takes its name of "horned" poppy. Of the *Geraniaceæ* two specimens were found, namely, *Geranium sanguineum* and *Geranium lucidum* (shining crane's bill.) The former was very plentiful, and bore very large flowers. It is one of the most showy of our wild geraniums, with its bright purple petals. The foliage of *Geranium lucidum* often turns red, like *Geranium robertianum*, which plant it most resembles in flower, and makes a bright bit of colour among the grey limestone rocks. A plant of *Centranthus ruber* (the red spur valerian) was also discovered; the stem is stout, from one to two feet in height, bearing glabrous smooth leaves and cymes of handsome red flowers, of which the corolla tube is spurred. It was disappointing that time did not allow of further search for any of the Orchidaceæ, one of the specified orders of the day. Nevertheless the botanists were well supplied with several uncommon and interesting plants, and, considering that the time spent in collecting was only three hours, it may well be said that some conscientious work was done.

EMILY M. WOOD.

The Late Mr. R. A Proctor.

IT is with much regret that we record the sudden decease of Mr. Richard A. Proctor, who succumbed on the 12th September to an attack of yellow fever in New York while *en route* from his home in Florida to England, where he was about to engage in a lecturing tour. The scientific world has lost a vigorous worker and a singularly independent thinker. As an able, popular exponent of astonomy he had no equal, and his numerous papers on a great variety of subjects, both literary and scientific, were characterized by a breadth of treatment and clearness of expression which caused their author to be highly esteemed, not only in this country but on the other side of the Atlantic and in the Colonies. We purpose in an early number to give a portrait and sketch of Mr. Proctor's career.

Museum Notes.

BOOTLE FREE PUBLIC MUSEUM.—The portion of the Liverpool Royal Institution collections sold by the Committee and purchased by the Bootle Museum Committee from funds given for that purpose by Lord Derby and the Danson Trustees, is now displayed in the rooms of the Bootle Museum. The Curator is at present engaged in arranging the collection of birds in orders and families. The whole of the *Raptatores* and the *Levirostal*, *Tenuirostral*, and *Fissirostral Passeres* have been put in position. As the Curator is also Librarian of the Free Library his time is divided, and the work of arrangement proceeds but slowly. A collection of *Hydroid Zoophytes* and *Bryozoa* has been named by Dr. Bark, the chairman of the committee, and the Curator, and mounted on black cards in one of the cases. The collection of minerals is well worth a visit. The same thing may be said of the fossils, although they are but broadly classified at present. A series of Monthly Museum Addresses will be given in the winter. Mr. John Vicars will probably talk about the Ladder of Life, Coal, and Ores and Metals. The Curator will most likely describe the swimming birds, rocks, and precious stones in the Museum.

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COMMERCIAL MUSEUMS.—Referring to a note which appeared in our last issue with regard to commercial museums, we may now call attention to the following information given in the *Board of Trade Journal* respecting the museums at Milan, Buda-Pesth, Oporto, Frankfort and Tangiers.

It is stated that, although opened so recently as June, 1886, the Milan Commercial Museum has already rendered important service to Italian industry. During 1887 a great deal of business was effected entirely through this museum, so that the Italian Government is beginning to waken up to the value of the institution, and has shown this by an increase in the subsidy. The museum publishes a bulletin twice each month describing all specimens received since the last publication, and adding all facts about general information which are considered important in connection with the export trade.

THE Belgian Consul-General at Buda Pesth sends a very favourable report concerning the commercial museums established there by the Austro-Hungarian Ministry of Commerce. This receives a subsidy from the Government, augmented by contributions from the Chamber of Commerce, from the Austrian Lloyds, and from various societies. The object of the museum is to exhibit more especially what is manufactured in Hungary, and thus to show the Hungarian nation of what its own products consist. This museum is not merely an exhibition, but a vast market as well, and occupies the large space engaged for the Pesth Exhibition of 1885.

THE commercial museum at Oporto, opened in March last year, has proved very successful. Most of the articles exhibited are Portuguese, and many of these are specimens of the domestic trades of Portugal.

THE report of the Frankfort Chamber of Commerce shows that 6,539 persons visited the commercial museum in that city during 1887, and that its condition is very satisfactory, and its collections are being rapidly added to.

IT is intended to open in Tangiers, in Morocco, in October, an international commercial museum for the purpose of encouraging trade between that empire and foreign countries, and of familiarising the Morocco merchants with articles imported from Europe.

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MUSEUM AT CHEDDAR.—With respect to the caves at Cheddar, Somerset, which we mentioned last month, it may now be added that a valuable museum exists there, the result of the work of Mr. Cox-Gough. This was recently visited by the Somerset Archæological Society, and the objects there collected were discoursed upon by Professor Boyd Dawkins. Many of these objects represent remains of animals obtained in removing many tons of rock near what is known as the High Rock, Cheddar Cliffs. They consist of teeth and bones of the Irish elk, the bison, cave bear, roe-deer, stag, hind, rhinoceros, wild horse, and some human remains. There were also many coins of the Roman period, and fragments of early British pottery. As illustrating scientific research in that particular locality, this museum is of great practical use.

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Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between August 16th and September 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board:—

(*a*) Barometer	Highest (September 13th)	30·50	Inches.
,, ,,	Lowest (August 24th)	29·50	,,
,, ,,	Mean	30·024	,,
,, ,,	,, for 21 years August	29·928	,,
,, ,,	,, ,, September	29·909	,,
Temperature	Highest (August 25th)	68·0	Deg. F.
,,	Lowest (September 8th)	44·7	,,
,,	Mean	56·6	,,
,,	,, for 21 years August	60·6	,,
,,	,, ,, September	56·3	,,
,,	,, of Evaporation	52·8	,,
,,	,, ,, for 21 years August	56·5	,,
,,	,, ,, ,, September	52·9	,,
(*b*) Rainfall	Amount	2·431	Inches
,, ,,	,, Mean for 21 years August	2·701	,,
,, ,,	,, ,, ,, September	3·484	,,
,,	Number of Days on which Rain fell	20	
,,	Greatest fall in 24 Hours (August 28th)	0·716	Inches
Cloud	Mean Amount (0 indicating clear sky 10 overcast)	7·3	
,,	,, ,, for 21 years August	6·3	
,,	,, ,, ,, September	6·5	
(*c*) Wind	Velocity Greatest (August 29th)	39	Miles.
,, ,,	,, Least (August 18th)	1	,,
,,	,, Mean Hourly	14·0	,,
,,	Greatest Pressure on Square Foot (Sept. 6, 1·15 p m)	15·4	Pounds.
,,	Direction at time of Greatest Pressure	WSW	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
71	50	147	57	137	188	62	32	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

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The Weather, August, 1888.

There was a band of even pressure over the country at the beginning of August, the barometer ranging from 29·93 in. to 30·02 in., and pressure remained high till the 4th. On the 5th pressure declined, but increased again to over 30.0 in. on the 6th. It fell in the North on the 7th and 8th, but kept high in the South; and from the 9th to the 11th it was again above 30·0 in. all over the country. On the 12th a depression appeared in the West, and travelled across the country on the 13th, with its centre over Scotland, and the barometer fell to 29·40 in. On the 14th pressure recovered, and was high (above 30·0 in.) till the 20th, when a depression again travelled from the West, and the barometer was low (29·40 in.) till the 24th. Pressure increased on the 25th, but from the 26th to the 29th a series of depressions passed across the country, and the barometer again fell to 29·40 in. On the 30th pressure recovered, and exceeded 30 inches all over the country at the end of the month. It will be seen from the above that pressure was not so constantly varying as in the previous month, and there were longer periods of fine weather. From the 1st of September to the 6th pressure was low and irregular, but from the 6th to the 15th it has been high all over the country, never falling below 30·0 in., and at times as high as 30·50 in.

	TEMPERATURE.							RAINFALL.				
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for August.* Daily Max.	Means for August.* Daily Min.	Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Aug.* Ins.
Sheffield ...	79°	9th	44°	19th	56°	—	—	2·417	12	1·23	28th	—
Spurn Head.	75°	7th	47°	19th	58°	—	—	1·83	15	0·56	24th	—
York	79°	9th	41°	19th	57°	68°	51°	1·74	16	0·71	28th	2·47
Barrow	69°	10th	45°	16th	56°	—	—	4·23	18	0·88	4th	—
Liverpool ...	75°	10th	46°	19th	58°	66°	54°	2·83	20	0·72	28th	2·79
Holyhead ...	68°	12th	45°	18th	57°	64°	55°	2·25	19	0·48	4th	2·89
Oxford	80°	10th	40°	19th	58°	69°	53°	1 82	13	0·67	28th	2·33
London	85°	10th	44°	3rd	60°	72°	54°	3·15	11	1·26	1st	2·20

* The means of Temperature and Rainfall for August are for 15 years.

From the 12th to the 19th of August, although the weather was cold for the time of year, it was fine in most parts of the kingdom, after the passage of the depression on the 13th. In London there was no rain for thirteen days (from August 7th to August 19th), and during the same period there was rain on four days only in Liverpool, two in Oxford, three in York, and four in Barrow. There was frost on the 19th in the North-East of Scotland.

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The barometer was giving way at the end of the week, and from the 19th to the 25th the weather was very changeable and unsettled, with thunder in many parts of the kingdom. There was rain on every day of the week at Liverpool, on six days at Holyhead and York, five days at Barrow, four at Oxford, and three in London. Temperature was uniformly low in the extreme North and North-West, but over the Eastern parts of Great Britain it occasionally rose above 70°, the highest readings being on the 24th, when it registered 75° at London and Cambridge. From August 26th to September 1st the weather continued unsettled, improving towards the end of the week, but temperature was low. On the 28th the rainfall exceeded an inch at Loughborough, Pembroke, and Sheffield. The highest temperature in England during August was 85° at London and Cambridge on the 10th, and the lowest was 38° at Loughborough on the 15th, while in Scotland the lowest temperature was 35° at Aberdeen on the 19th.

In the first week of September the weather remained in a showery unsettled state, and there was rain at most places in the kingdom, with thunderstorms in some of the Midland and South-Eastern Counties on the 7th, after which date the weather became much more settled in character, and anticyclonic conditions have since prevailed, with fine weather generally, but low night temperatures, though the amount of sunshine was large for the time of the year. During the first seven days of September there was rain on every day in Liverpool, five at Barrow and London, and four at York; but from September 7th to the 14th there was no rain in Liverpool, and the rainfall over England was very small. E. Howarth, F.R.A.S.

Sheffield, September 15, 1888.

Bolton.

The latter half of August fully maintained the cold, humid character of the first fortnight, making agriculturalists' hopes sink to zero. During the week ending August 21st the corrected mean temperature only averaged 52°; barometer unsteady; rain, on three days, to the depth of 0·467 in.; on five days, a total of 18 hours 21 minutes sunshine; relative humidity 77%. From the 22nd to the end of the month the corrected mean temperature was 54·35° (still below the average); barometer unsteady and mean low; rain fell on eight days to the depth of 2·129 in.; on seven days 33 hours 3 minutes sunshine was recorded; relative humidity 85%.

The means for August:—Barometer 29·999 in.; corrected mean temperature 54·42° (about 3° below the average); rainfall, on nineteen days, 4·432 in. (slightly in excess of the average); sunshine, on twenty-one days, to the total of 101 hours 24 minutes, or only 23% of possible amount; relative humidity 81%. Distant thunder was heard on the 1st and 29th, and thunder and lightning on the 24th. Contrasting the months of June, July, and August with the corresponding ones of 1887 I find the following differences in the records:—Barometer, a mean of 0·166 in. lower; mean temperature 3·76° less; sunshine a total difference of 240 hours; and of rainfall a total difference of 9·348 in. more: the temperature of the soil at one foot deep shows a mean daily difference of 3·5°; while in the amount of available heat for vegetable growth (that is, the amount exceeding the temperature of "growing point") there has been a mean daily difference of 6·5° less.

The first week in September showed no improvement; barometer unsteady; temperature variable with a mean of 53·25°; rained every day, total 1·377 in.; sunshine on three days—total 16 hours 37 minutes; humidity 89%. On the 8th an anticyclone set in and continued to the close of the week, the average pressure being 30·366 in.; temperature variable, improving towards the close of the week—mean 51·93°; 0·018 in. of rain fell on the 11th; more or less sunshine occurred each day, with a total of 25 hours 16 minutes; humidity 72%.

W. W. Midgley, F.R.Met. S.

Met. Observatory, Bolton, September 19, 1888.

Astronomical Occurrences in October.

The only planet visible during the month is Saturn, and, as he does not rise till 1 o'clock in the morning at the beginning of the month and at 11-30 p.m. at the end of the month, we will defer further particulars of him till next month, when he will be visible at a rather more convenient time. The Moon is new on the 5th at 2-34 p.m., attains her first quarter at 5-29 a.m. on the 12th, and is full at 9-8 p.m. on the 19th, the last quarter phase being at 1-56 a.m. on the 28th. A 4th magnitude star in Cetus will be occulted by the Moon at 11-39 p.m. on the 20th, reappearing at 41 minutes after midnight. On the 24th there will be an occultation of a star of 4½ magnitude in Orion at 9-2 p.m., reappearing at 9-56 p.m.

Societies.

Liverpool Geological Association.—The monthly meeting was held at the Free Library, on Monday, September 3rd, when a paper was read by the Rev. S. Gasking, B.A., Vice-President, entitled "Geological Notes Taken During a Recent Visit to Canada." He first described the voyage experiences amongst icebergs, noting the strange forms produced by the erosive action of sea waves and atmospheric agents, and then narrated his observations on ice action on the land along the St. Lawrence valley. The Falls of Niagara and building stones used in the various Canadian cities were also briefly passed in review in his paper, which was illustrated by a series of minerals and rock specimens, including a specimen of the noted *Eozoon Canadense*. There was also on view at this meeting a tray of fossils collected by Mr. R. Jackson from the gravel pits near Oxford, which included a tooth of the *Elephans Meridionalis*, much decayed and broken, a tooth of the *Rhinoceros techorinus*, *Scutella Subrotunda*, a number of cretaceous ammonites, and many rolled fragments of Lias and Oolite fossils, principally Gryphea and Belemnites.

Natural History Society of Glasgow.—The last meeting of the summer session was held in the Society's rooms, 207, Bath Street, on Tuesday, 11th September; Mr. R. Turner, Vice-President, in the chair. Mr. M'Culloch exhibited an albino specimen of the red grouse. Mr. Steel exhibited three specimens of *Cephalopoda Loligo vulgaris*, and dissected them to show the shell, beak, odontophone, and ink-bag. This species, although common on the East, is not met with on the West Coast. Mr. Steel then showed some fine specimens of the zoophyte family, including *Flustra foliacea* and *Flustra securifrons*; also a specimen of the *Poriphora* class, *Chalina oculata*. Mr. R. Broom, B.Sc., drew the attention of the members to the recent advances which have been made in our knowledge of the carboniferous fishes of the genus *Pleuracanthus*. The spines and teeth have long been known, but recently M. Brongniart, of Paris, has been able to make an almost complete restoration of this remarkable form from some very well-preserved specimens found in France. Mr. Broom pointed out the chief anatomical features of the genus, and its relations to the sharks, chimæras, and ceratodus. Mr. Broom afterwards showed some microscopical specimens of the retina of the stickleback and lamprey, and made some remarks on the coursing of the fibres and the peculiar nervous elements found in the retina of the lamprey. Mr. R. Turner exhibited a fine collection of diatoms.

The Warwickshire Naturalists' and Archæologists' Field Club.—On Monday, September 3rd, the final summer meeting of the Warwickshire Naturalists' and Archæologists' Field Club was held at Wilmcote and adjacent district. About thirteen members assembled at the station at one o'clock p.m., the archæologists driving to the following places of archæological interest, viz., the churches of Wilmcote, Billesley, Binton, the Norman church at Welford, Weston-on-Avon, and Clifford Chambers. The geologists, some eight or nine in number,

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headed by their President, and under the guidance of Mr. M. H. Lakin, also a member of the Club and owner of the quarries, proceeded at once to examine the sections, which were described in detail by the Rev. P. B. Brodie, President. These quarries exhibit a series of limestones divided by clays in regular order, to a depth of many feet, and form the lower beds of the Lias, the Aplanorbis zone and insect beds, the former being the characteristic ammonite, and the latter the characteristic annulosæ. Many fine saurians and fish also occur in these quarries. No good ones were obtained on this visit, but a probably new fern was found, and will be presented by Mr. Lakin to the Warwick Museum. Some of the limestones form good paving stones, and are used to make hydraulic lime. After a careful inspection of these fine sections, the finest ones in the lower Lias in the county, the party drove by Billesley to the once famous (now closed with one exception) quarries at Binton, on the same geological horizon and containing similar fossils, but far richer in the remains of insects, which have sometimes been discovered here nearly entire, including wings finely preserved of large neuroptera. They are confined chiefly to the lower zones of limestone, the bottom one being the richest. A remarkable cone was also found here, now in the collection of Mr. Brodie. It belongs to a cycadaceous plant belonging to the group Zamieai, and is new to the Lias. These are the only localities now where these lower beds of the Lias are worked; but similar ones are to be seen at Barrow, in Leicestershire, and Street, in Somersetshire. Some fine crustaceæ also occur in these beds, and a rare one of the genus Æger, in beautiful preservation and of large size, from Wilmcote, will be figured and described by Dr. Woodward in the *Geological Magazine* for this month. Owing to the shortness of time the geological section could not visit the cutting at Summer Hill, near Bidford, where a complete section of the Rhoetics is exposed, and highly fossiliferous; this would have shown a series of shales and clays, including stony bands, which immediately succeed the Lias, and are intermediate between the latter and the trias. These are characterised by a peculiar set of fossils, and are probably passage beds between the two formations. On the way to Stratford, passing Binton Hill on the right, the President observed that it was composed of higher strata than those already visited, being the equivalent of the Ammonites Bucklandi and angulatus zones at Harbury cutting, near Leamington. So that there is represented here the main portion of the lower Lias in regular descending order, down to the underlying Rhoetics, which are known to be present at about thirty feet below the lowest bed of limestone at Wilmcote. This was proved by a boring which the late Mr. W. Kirshaw, an excellent geologist, had made there many years ago. This ended a very instructive and pleasant excursion. And the day, fortunately in this wet summer, was very fine. The members dinedtogether at the Red Horse Hotel, Stratford.

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Puffin Island Biological Station.—This most charming marine station continues in full working order, and has been largely taken advantage of by students during the summer. Besides those from Liverpool University, several students from London, Manchester and Chester have worked there during their recess, some of the results of whose labours will be laid before the Liverpool Biological Society during the coming winter. Several of our professors and teachers of biology have also visited the station, including Professor Herdman, of Liverpool, Professor Phillips, of Bangor, Mr. Hurst, of Owens College, &c. Mr. Rutherford, the curator, sends weekly reports to the Liverpool Marine Biological Committee of all the work done; also daily reports as to wind, weather, &c. The recent reports show that the weather has been very favourable for shore collecting, the abundance of rocky pools disclosed during low water at each end of the island rendering it a peculiarly valuable locality in this respect. The profusion of *laminaria* and other forms of Algæ which clothe the rocks in such abundance form the home of numerous Amphipoda, Isopoda, and other Crustacean life, which are separated as the fronds are agitated in fresh water. The townet has been brought into active requisition during the late fine weather with the best results. Mr. I. C. Thompson, who has special charge of this department, and to whom the tow-netting material is regularly sent, reports a number of rare and valuable captures of microscopical forms, especially during several recent night hauls. Amongst other things Mr. Thompson has found *Euterpe gracilis*, *Pontella Wollastoni*, and *Cyclops Puffini*, three rare Copepoda, almost confined apparently in Britain to the water round Puffin Island. Professor Herdman has also just found *Lichomolgus sabellæ*, a new species of Copepod first found a year ago at Beaumaris. The lovely irridescent *Pleurabrachia* has also been abundant about the surface and taken in the tow-net, and with it a few specimens of *Tomopteris* in the night hauls. *Ceratium tapis* and other *Peridinea* have also been plentiful, especially since the disappearance of the minute floating diatomaceous Algæ of very gelatinous consistence, which was so profuse about the sea during the summer months, and rendered tow-netting difficult from its tendency to choke the fine meshes of the net. It is intended to keep the station open during the winter should the funds permit, and several students are desirous of studying forms of life only then procurable.

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The International Geological Congress.—The Fourth Triennial Congress of Geologists opened at London on 17th September, with an address by the president, Professor Prestwich, who reviewed the work done at previous meetings, and suggested the work of the London Conference. The execution of a geological map of Europe, as decided at the Berlin Congress, was far advanced, and the unification of geological terms was in the hands of nine national committees. The object of their deliberations was to reduce the various terms to be used to the expression of definite objects. Thus "group" would be applied to the great rock divisions—primary, secondary, tertiary. The sub-divisions would be called "systems," as, the Silurian system. The minor divisions would be "series," as the Oolitic series, the terms *Etage* and *Assize* being introduced for the smaller sub-divisions. In like manner, in regard to time, the terms recognised would be era, period, epoch, and age. In regard to the nomenclature of fossil organic remains, the name which would be retained for each species would be that under which it was first known, on the condition that it was then properly described; but no date before the twelfth edition of Linnæus, 1766, would be recognised as to priority. The president and Mrs. Prestwich afterwards held a reception in the large library of the University. Amongst the subjects discussed during the remaining meetings of the Congress were:—The Classification of the Cambrian and Silurian Rocks, and of the Tertiary Strata. A special sitting was devoted to a discussion on the crystalline schists. In the following week, excursions were held to the Isle of Wight (directed by Mr. Whitaker); North Wales, (Dr. Hicks, Professor Blake, and Mr. G. H Morton); East Yorkshire (Messrs. J. W. Woodall, C. Fox Strangeways, and G. H. Lamplough); Norfolk and Suffolk (Messrs. Clement Reid and J. E. Taylor); West Yorkshire (Messrs. J. E. Marr and R. H. Tiddeman); and Central England (Professor A. H. Green and Mr. H. B. Woodward). The number of geologists present at the Congress exceeds 200, representing 22 different countries.

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Thirsk and District Naturalists' Society.—At a meeting on Monday, September 17th, the Chairman (Mr. Leonard Thompson) gave a microscopical exhibition of spores which he had obtained from wheat straw in the neighbourhood. He also showed a fine specimen of the *Sirex gigas*, or tailed wasp, which he had caught during the day. Mr. Foggitt said that tailed wasps were not natives of this country in one sense, for they were never bred here. The insect bored into the pinewood in its native home, Norway, and did not become matured or developed for three years. Specimens had been captured in and near the town at different times, and had been exhibited by their captors as hornets, to which they had some resemblance. Mr. Robert Lee,

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vertebrate secretary, showed a very fine herring gull, which had been shot at Plump Bank, just outside the town. He also mentioned that a scoter, a bird seldom found so far inland, had been caught near the railway station, but had since died; and that a Manx shearwater had been captured in the Castle yard.

LEEDS NATURALISTS' CLUB AND SCIENTIFIC ASSOCIATION.—The members of this Club met on Monday evening, September 3rd. Mr. W. Clapham exhibited several ingenious microscopical appliances of his own construction, and showed that in place of the costly "spot lens" an efficient substitute could be made from an artificial fish eye, mounted in a tube to fit under the stage of the microscope. A very handy section cutter, consisting of the usual brass disc with a hole in the centre communicating with a short tube beneath, in which the object to be worked upon was pushed up by a screw arrangement, was next exhibited. By a simple indicator, it was explained that it was possible to produce sections down to the five-hundredth of an inch. Another section cutter, made on the principle of the Cambridge rocking microtome, out of sundry homely articles, such as clock wheels, springs, &c., was stated to be capable of dividing to the three-thousandth part of an inch. The following plants, collected at a previous field meeting in the vicinity of Seascale, Cumberland, were examined:—Sea holly (*Eryngo maritimum*), sea-side convolvulus (*Convolvulus soldanella*), bloody crane's bill (*Geranium sanguineum*), rest harrow (*Ononis arvensis*), Isle of Man cabbage (*Brassica monensis*), sheep's bit (*Jasione montana*), scarlet pimpernel (*Anagallis arvensis*), burnet-leaved rose (*Rosa spinosissima*), sea-thrift or sea-pink (*Armeria maritima*), buck's horn plantain (*Plantago coronopus*), field gentian (*Gentiana campestris*), saw wort (*Serratula tinctoria*), lesser stitchwort (*Stellaria graminea*), tutsan (*Hypericum androsæmum*), perforated St. John's wort (*Hypericum perforatum*), trailing St. John's wort (*Hypericum humifusum*), large-flowered hemp nettle (*Galeopsis versicolor*), spiked purple lossestrife (*Lythrum salicaria*), tea campion or catchfly (*Silene maritima*), biting persicaria (*Polygonum hydropiper*), sweet bay-leaved willow (*Salix pentandria*) in fruit, monkey flower (*Mimulus lutea*), red Bartsia (*Bartsia odontites*), named after John Bartsch, a Prussian botanist, and friend of Linnæus; golden rod (*Solidago virgaurea*), sneeze wort yarrow (*Achillea ptarmica*), fine-leaved heath (*Erica cinerea*), glass wort (*Salicornia herbacea*), sea blite (*Suæda maritima*), kidney vetch or lady's fingers (*Anthyllis vulneraria*), common burnet saxifrage (*Pimpinella saxifraga*). Mr. W. Kirkby called attention to the saw wort (*Serratula tinctoria*), of which he gave the following note from Smith's *British Flora*:—"This plant gives a yellow colour to wool, for which purpose Linnæus says it is much used in Sweden. Haller records, on the authority of some foreign writers, that the above colour, fixed by means of alum, is both beautiful and permanent, and, with the addition of blue, makes a better green than either reseda luteola or genista tinctoria for dyeing wool or silk."—At the meeting of this Society, on Monday, September 17th, Mr. H. Marsh, F.R.C.I., pointed out the disadvantages of setting insects when the wings are held in position by slips of paper secured by entomological pins, and suggested an improvement on this method by having setting boards cut into short lengths sufficient for one insect only. The insect being placed in position, and a length of soft cotton or floss silk wound around the board, the wings were passed over and secured with the minimum of pressure and entire absence of friction. As the sawn ends of the pieces of setting board were left rough, the cotton adhered with sufficient firmness, and needed no securing at the end of the operation. Mr. Marsh also demonstrated a method of preserving larvæ. For this purpose an incision was made in the anal segment of a caterpillar, which was then placed between two pieces of blotting-paper, and the contents of the skin were exuded by passing a roller over the insect, beginning of course at the head. The flattened empty skin was next inflated by a continuous stream of air, and at the same time was dried in a small improvised oven over a lamp.

LANCASHIRE AND CHESHIRE ENTOMOLOGICAL SOCIETY.—This Society commenced its winter session on the 24th September, with a conversazione at the Royal Institution, Colquitt Street, Liverpool. There were numerous and excellent exhibits, and also interesting lectures. Amongst the exhibits was the fine collection of British lepidoptera made by Mr. S. J. Capper (the President of the Society), which comprises varieties of great beauty and value. There were some fine sketches in water-colour of lepidoptera, shown by Mr. Mossloy, of Huddersfield; and Mr. Wilding, Hon. Secretary, exhibited a case containing many specimens of beetle life of this country, while Mr. J. T. Middleton contributed several cases containing silk in various stages. This gentleman also gave a lecture on sericiculture. The Hon. Librarian of the Society, Mr. C. H. H. Walker. discoursed on "England's Sunny Lanes and their Insect Inhabitants," illustrating his lecture with many rapid but well-executed crayon sketches of the tiny denizens, with whose haunts and habits he showed himself thoroughly familiar.

MANCHESTER MICROSCOPICAL SOCIETY.—At a meeting of this Society Mr. James Hart, F.C.S., read a paper on "Insect Powder." He described the insect powder in most common use to-day, which is prepared from the flowers of *Pyrethrum roseum*, or *P. cinerariefolium* the former known as Persian, and the latter as Dalmatian insect powder. The powder from Dalmatian flowers was acknowledged to be the best and strongest, owing, perhaps, to the fact that fewer double flowers were found in it than the Persian. More than twenty years ago a German traveller described this powder as a sure protection against all kinds of insects, and by making a tincture of the flowers, diluting it with water, and sponging his body, he was enabled to sleep without even the protection of the mosquito net. An American naturalist described the action of the powder on different insects. The smell did not affect them, but, when carried to the maxillæ or mandibles, complete paralysis of the motor nerves took place, the legs being naralyzed in regular order, beginning at the first pair. Different classes of insects were susceptible in varying degrees to its influence, all insects having open mouthparts being peculiarly liable to its influence, whilst others, such as the Hemiptera, owing to their peculiarly-shaped mouths, were able to vigorously resist it. The plant itself was quite inactive and utterly valueless as an insecticide The best powder was prepared from half-open or closed flowers, that prepared from open flowers being much weaker. Mr. Hart drew attention to an adulterated powder which was being sold in large quantities in the district at a price fifty per cent. below that at which the genuine could be procured. This powder was made by grinding up the entire plant, which, as before stated, is innocuous. It also contained at least twenty-five per cent of wheat starch and twelve per cent. of yellow ochre, so that the insects who come across this so-called insecticide could devour twenty-five per cent. of it with impunity, and the rest would not have the slightest effect upon them. Mr. Edward Ward mentioned an instance of what he considered as communication on the part of ants. Wishing to obtain some he found that they climbed a certain plant, from which he could brush them into his collecting bottle, but after a time very few ants came upon the leaves, and those that did so turned back, his impression being that they had been warned by others of the danger attending such a course. He gathered a number of flowers of the mallow (*Althæa officinalis*), the anthers and pollen grains of which make such beautiful microscopic objects. He had found that in preparing it from the fully-opened flower most of the pollen grains fell off, whereas, by gathering the unopened buds, stripping off the leaves, and drying the anthers out of reach of dust, much better results were obtained. He had also noticed that wheat was largely infested by a fungus (*Ustilago segetum*) commonly known as the corn smut. This fungus, however, does not damage the flour, as the fungus reaches maturity, dries, and is scattered by the wind before the corn is ripe.

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The other fungus which affects wheat, the wheat bunt (*Tilletia caries*), is not so common but is much more destructive, and is a more insidious foe to the farmer. In the case of this fungus the ears of wheat remain green, and externally there is no appearance, except to the practised eye, that anything is wrong. There is no black impalpable dust about the ears as in "smut," but stealthily and secretly the work is accomplished, and until the bunted grains make their appearance in the sample the disease may, perchance, be unchallenged. When the grain is broken the farinaceous interior will be found replaced by a minute black dust of a very fœtid, unpleasant odour, and greasy to the touch. Flour which contains a large proportion of bunt is injurious in proportion to its extent. The prevalence of these fungi on wheat is due to the wet summer we have had, as it is well known that many fungi flourish in proportion to the wetness of the season. On the ramble to Ashley in August barley was seen largely infested with smut.

THE SCOTTISH CRYPTOGAMIC SOCIETY.—The fourteenth annual conference of this Society was held at Inverary, on the 12th September. The proceedings commenced with a council meeting, over which the President (the Rev. Dr. Macmillan, of Greenock) presided; and it was arranged that the next conference should be held at Crieff. In the early part of the afternoon the members were entertained at Inverary Castle to luncheon, by the Duke of Argyll, the president for the current year. Here a fine collection of specimens interesting to the Society was arranged for public inspection in the pavilion. In the afternoon the members, several of whom had been very active in collecting specimens in the morning, made excursions in search of objects of interest to them. At night the annual meeting was held in the Castle Pavilion, when a brilliant company assembled. The Duke of Argyll, who presided, said they were delighted to receive the members of the Cryptogamic Society, and to be instructed by them on the beautiful natural forms which were abundant in this neighbourhood. He said that they knew that the great mass of our coal was due to the crushing and preserving of cryptogramic flora of that day. Very often the vegetable structure was brilliantly exhibited, if not in the coal in the shale, and they found almost the whole of the vegetation, the enormous peat beds and peat mosses which had now been hardened into coal, were of the very kind of vegetation to which his friends devoted their energies. He recommended to the Society, as an interesting branch of inquiry, an investigation of the poisons which were contained in non-edible fungi. A vote of thanks was passed to the Duke for his address. Colonel Harrington-Steuart (Torrance) submitted a contribution on "Edible Fungi." He said that it was to be regretted that the poor of this country did not make use of the large amount of wholesome food, in the shape of edible fungi, which grew at their very doors. He gave some directions by which poisonous fungi could be distinguished. The Rev. Dr. Macmillan (Greenock), the Vice-President, read a paper on "The Lichens of Inverary," where, he said, owing to the great extent of old shady woods in the neighbourhood, the lichen flora was unusually luxuriant. Professor Traill (Aberdeen) spoke of the discoveries that had been made of Scottish fungi since 1879, and in conclusion made some remarks on the alterations that certain parasitic fungi produced in the tissues of plants that they attacked.

CHESTER SOCIETY OF NATURAL SCIENCE.—The seventeenth conversazione took place on the 24th September, at the Town Hall, Chester, and was attended by over 800 people, including a number of distinguished foreign scientists, members of the International Geological Congress, who have been engaged at the meeting of the Congress in London, and are now *en route* for geological explorations in this country. The gentlemen were:—Prof. Com. G. Capellini, Rettore del Università di Bologna; Herr Prof. Dr. Joseph Szabo, Buda-Pesth; Prof. A. de Lapparent, Professeur à la Faculté Catholique, Paris; Herr Prof. Dr. K. Von Zittel, Munich; Prince Roland Bonaparte; Mons. le Prof. T. Gosselet, Lille; Colonel Joaquim F. N. Delgado, Lisbon; Mons. le Prof. Eugene Renevier, Lausanne; Herr Franz Posépny, Bergath und Prof. au den Bergakademu zu Pribram, Vienna; Madame Clotilde Posépny, Vienna; Herr Prof. Dr. T. Lehman, Kiel; M. A. Inostranzeff, Prof. de Géologie à l'Université de St. Petersbourg; Mons. le Dr. Charles Barrois, Lille; Dr. Frederick Schmidt (St. Petersburg); Ih. Ischernyschew (St. Petersburg); Herr Dr. Baron Sidney Wohrmann (Munich); Mr. C. D. Waldcott, F.G.S., Geology Survey, U.S.A; Mrs. C. D. Waldcott, M. Ernest Van Den Broeck, Secretary Soc. Belge de Geologie, Bruxelles; Mons. A. Rutot, Conservateur an Musée Roy d'Hist., Bruxelles; Herr Prof. Dr. E. Kayser, Marburg; Mons. Alphanse Bioche, trés. de la Sec. Geol. de Paris; Madame Bioche, Dr. Hans Rensch (Christiania), Dr. H. Hicks, F.R.S., F.G.S., director, Dr. Nils Olaf Holst (Sweden), M. Ch. Lahaye and M. Albert H. Haukar (Brussels), Herr Dr. R. Schäfer (Munich), Mons. Vladimir Vernadsky (St. Petersburg), Dr. Fritz Frech (Halle a Saale), Dr. Robt. von Gomburg (Vienna), M. le Prof. Georges Zlatarski (Sofia, Bulgaria), C. H. Homan, F.G.S. (Christiania), Prof. Joseph Kleiber (St. Petersburg), M. A. Bigot (Paris), Sig Ettore Mattirola (Torina, Italy), Dr. Xavier Stanier (Brussels), Herr Dr. E. Fraas (Munich), Dr. Baltzer (Bern), M. Kravsnow (St. Petersburg), Dr. G. A. F. Molengraaf (Haarlem), M. E. de Margorie (Paris), M. le Dr. Ladislaz Szajnocha (Cracovie, Galicia), M. le Dr. Maurice Hovelacque (Paris), M. le Prof. G. Pilar (Austria), Mons. Pierre Armachewsky (Kiew, Russia), Mons. F. Loewinson-Lessing (St. Petersburg), and Prof. J. F. Blake, M.A., F.G.S., director. Among the exhibits, the greatest attention was attracted by an interesting display of gold ores from various parts of Merionethshire and other places in the Principality, collected by Mr. T. A. Readwin, F.G.S. (of London). Together with the specimens of ores were some ancient coins, including a rare £3 piece of Charles I, and a number of coins dating from 1642-46, the product of a mint set up by one Thomas Bushell, at Shrewsbury, who obtained a special grant from the King to coin silver and gold. There is evidence that a great part of this coinage was struck from native metal obtained from mines in Cardiganshire and Merionethshire. Permission was also granted in the thirteenth year of King Charles's reign for a mint to be established at Aberystwith. All money minted here is marked with a plume of feathers to distinguish it as Welsh metal, besides the usual mint marks. Another interesting exhibit consisted of a series of fossils from the Bala beds, which included several species not usually to be found. Mr. G. A. Dickson supplemented this collection with a number of other fossils from Bala and Wenlock, in which the varied species of trilobites and beautiful forms of limestone corals were well represented. There were also exhibited the choice collection of coleoptera, micro-lepidoptera, birds and skins, bees, wasps and sand wasps, collections of cut herbaceous flowers, and geological specimens. An interesting microscopical exhibition was given in the Council Chamber, special attention being paid to the display of living micro-organisms obtained from the ponds and ditches of the neighbourhood. The collection of fossils, trilobites, phyllopods, pteropods, brachiopods, &c., by Mr. G. J. Williams, of Blaenau Festiniog, was displayed. A selection from Mr. Stvens's collection of British and foreign birds, numbering about 1,500 specimens, was exhibited. In No. 1 committee room were shown specimens illustrative of the insect life of the society's district; while the Photographic section displayed a large series of photographic views, which were shown by the aid of the lantern. Prizes for distinction in various branches of scientific research were presented to the following:—The Kingsley Memorial Medal, awarded for having contributed materially to the promotion and advancement of some branch or department of natural science, to Mr. T. Shepheard, F.R.M.S.; Kingsley Memorial Prize of £5, for collection of coleoptera, consisting of 270 species, to Miss Lilian E. Tomlin. Grants from the Kingsley

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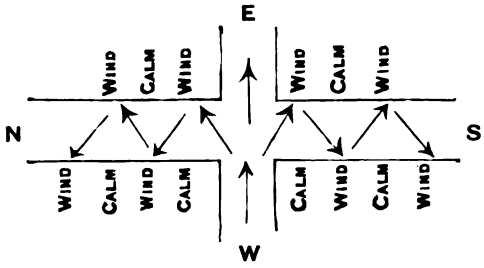
Memorial Fund for the encouragement of scientific research:—To Mr. J. Arkle, £3 for collection of micro-lepidoptera; to Mr R. Newstead, Sen., of Ince, £3, for collection of birds and skins, also collection of macro-lepidoptera; to Miss Edith C. Tomlin, £1 for collection of bees, wasps, and sand wasps; to Dr. Stolterfoht, the sum of £1 1s. for collection of micro-photographs. Additional prizes were awarded to the following members of the photographic section:—Landscape, Mrs. T. Hignett; architectural, Mr. F. Evans; instantaneous work, Mr. F. T. Farrimond; and life studies, Mr. E. W. Pulling. Addresses from several of the foreign visitors and others were afterwards delivered, and altogether the meeting was of an enjoyable character.

Direction of Wind Currents.

The behaviour of winds when striking against a cliff or in confined places is often very curious, and it may be of interest to mention a few examples which have come under my notice.

Some time ago, whilst staying at Walton-on-the-Naze, I noticed that, when a strong wind is blowing from the sea, no evidence of it is felt immediately in front of the Cliff, but above, where no impediment exists, the current is very strong. This phenomenon admits of a simple explanation. The air in front of the Cliff remains stagnant, and gets perceptibly hot by the compression resulting from the wind pressure outside. This fact may have some bearing on the work performed by wind in disintegration.

Another feature I have frequently noticed, when walking along Bedford Street, Liverpool, when a strong westerly wind has been blowing. At such times the air you meet is alternately calm and windy. The wind is sometimes accompanied by rain, and then the



reason of this is most apparent. The wind striking the houses on the eastern side of the street (Bedford Street runs north and south) gets reflected, and remains in a column instead of being dispersed. This on striking the western side gets again reflected, and so on along the street. The accompanying diagram will make the meaning plain. The arrows show the direction of the wind. J. Lomas.

Reviews.

Nature's Fairyland, by H. W. S. Worsley Benison, F.L.S. [London: Elliott Stock, 62, Paternoster Row.

This book is written in a pleasant vein, with each fact clearly stated in such an interesting manner as to incite the reader to further science study.

Industries and Education in South Germany.

Professor Hele Shaw, of University College, Liverpool, one of the Hon. Secretaries of the Liverpool Association for the Promotion of Technical Education, has issued a pamphlet giving an account of his recent visit to South Germany. This report gives useful information respecting the industries of the localities visited, and testifies to the value of manual instruction as given to children during a certain portion of the school hours.

Descriptive Geometry, by Linus Faunce. [Boston: Ginn & Co., 1888. Oct. pp. 54, 16 plates.]

The author of this work, Mr. L. Faunce, is assistant professor of descriptive geometry and drawing in the Massachusetts Institute of Technology. His book gives in a condensed form the leading principles of geometry, treating of notation, problems relating to the point, line, and plane, cylinder, cone, double-curved surfaces of revolution, intersection of planes and solids, and is amply illustrated by clearly-drawn sets of figures. It should be of great use to students of mathematics and geometry, the explanations being well expressed; and, what is equally important in a work of this kind, printed in good readable type.

City of London College Science Society. Third Annual Report, 1887-8.

The Report of this vigorous society is very satisfactory. There are 85 members on the roll. The Treasurer's statement shows a balance of cash in hand, and, in addition to the reading of ten papers during the session, excursions have been held to eight localities, including some instructive visits to museums. The President of the Society is Sir John Lubbock, F.R.S., who, however, does not seem to have contributed anything to the "Proceedings." Amongst the papers printed are the following:—"The Value of Experiment in Biology," by Professor Boulger, F.L.S.; "Spiders," by G. E. Mainland; "Recent Researches in Botany," by H. W. L. Billington; "Food Preservatives," by B. H. Gerrans; and "The Geology of Italy," by F. W. Quick. Perhaps the most useful feature of the volume is the space devoted to accounts of the excursions and visits to works and museums, which are so written as to give some real information to others besides the necessarily limited number actually present on the respective occasions.

Planetary and Stellar Studies, or Short Papers on the Planets, Stars, and Nebulæ, by John Ellard Gore, F.R.A.S. [London: Roper and Drowley, 1888. pp. 264.

This new work contains a series of papers, some of which have appeared already in scientific periodicals, and in the proceedings of learned societies. In these, however, the information is brought up to date, and some chapters added which have not been previously published. The papers on Mercury, the minor planets, Uranus, Neptune, and the Distances of the Fixed Stars, are especially interesting. Amongst other subjects treated of by the author are Stellar Photography, the Zodiacal Light, Milky Way, and the Great Pyramid. Several excellent plates and illustrations are dispersed through the pages of this book, which will be welcomed by everyone who takes an interest in the entrancing study of Astronomy; whilst those who are not versed in the science will find much that is attractive in Mr. Gore's concisely-written essays.

New Apparatus.

In addition to notices of scientific books, we wish from time to time to mention new apparatus, &c., serviceable for purposes of investigation or for the teaching of students. We have noticed this month some excellent sets of apparatus sold at a remarkably cheap rate by Mr. Wm. Hume, of Edinburgh, for the study of experimental physics, and sent out with a small book indicating 120 experimental exercises for each set. These exercises are thoroughly well arranged, and calculated to lead a student through a systematic course of simple experiments which not only form an introduction to the study of each special subject, but give a large amount of information and experience in their manipulation. Either for private study or for the use of teachers in elementary classes, this series of apparatus will be found very handy.

Messrs. Wood (late Abraham), of Lord Street, Liverpool, have sent us for inspection Cathcart's improved microtome, and the improvements upon the original instrument are certainly of much value, resulting in steadier movement, and consequently more certainty and delicacy of employment is permitted, and the usefulness of the sections produced is greater.

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Research:

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NOTE.—We have several other articles, including reports of societies, in type, but are unwillingly obliged, for want of space, to hold them over till next month.

NOTICES.

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & Co. Price 3d., or by post, 4d. Annual Subscriptions 3s., or by post, 4s.

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Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Scientific Societies and their Work.

WHEN we consider how great is the number of persons who are members of Scientific Societies in different parts of this country, we may naturally expect from them year by year a vast amount of original investigation and useful scientific work, but, whilst there are many societies in which officers and members are thoroughly energetic in this direction, there are many others almost barren of results that can materially aid scientific progress. With regard to these latter, it is far too often that the papers read and work done are of a very desultory character, and give the impression that the officers responsible for organising meetings have been only too glad to get *anything* rather than fail to fill up their programme, and we know that oftentimes in some societies the secretaries are at their wits' end to obtain what they require. Then again, papers are too frequently mere summaries of existing knowledge, or hashes of the work and opinions of others without any attempt at healthy criticism or originality of thought or treatment on the part of the reader or lecturer. There is of course no reason why societies should not have before them, in the form of lectures and papers, an epitome of knowledge already gained, and indeed it is well, especially where there are student members, that there should often be given really good digests and criticisms of what is already known, but these should be so treated as to make a knowledge of known facts and theories serve as a fonndation for further work. It is the essence of science to move forward, and the scientific student should not rest satisfied with a knowledge of what has already been done.

Then again, very many members of societies attend meetings to take no other part than listen, and, consequently, the reading of papers, &c., and discussions are engaged in only by a few prominent members; and not infrequently the discussions, if they may be called so, consist of little more than unlimited praise of the paper or lecture and formal votes of thanks.

And whilst this may be said of indoor meetings, it is also true that many field meetings and other excursions are too often attended by members who are only present for a pleasant "outing," and who neither take part in working at the programme of the day, nor assist in any way in the scientific objects of the society. And these persons frequently hinder those who would work.

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Now, whilst we would urge that it should be the aim of every member of a society to take active part in its scientific work, we think there is often much fault, from want of organisation and tact, on the part of councils or committees and their officers. These may frequently, by careful study of their members, pick out those capable of taking part in original investigations, reading papers, discussions, &c., but who, either from want of confidence in their own powers, or lack of knowledge of useful subjects to proceed with, or how to commence work, are generally silent and inactive.

There is one way especially in which a council of a society may stimulate work, and that is in carefully considering and marking out from time to time lines of inquiry that can be readily taken up and worked at by their members. With a well considered programme of desirable investigations presented to them at the commencement of a session, or at other convenient time, many more members than at present would work in earnest, and contribute, not only to the success of the society, but to the progress of science generally. Take, for example, field work in connection with geology, botany, entomology, pond life, &c., the systematised work of members of local societies must result in valuable contributions to a scientific knowledge of the district. But, unfortnnately, at present these investigations are usually carried on by individual members without any concerted action or careful comparison of the facts ascertained. And in like manner there might be indicated many inquiries that can be readily conducted indoors. For instance, how greatly would our knowledge be extended if those who now use the microscope more as a scientific toy could be induced to work out, step by step, the structure and life histories of many organisms of which we now know next to nothing, or bring their instrument to bear upon different problems of plant-growth, or the nature and habits of some of our plant pests, and other subjects of like nature.

With a careful mapping out of work such as we refer to, there would be no difficulty with regard to papers and useful discussions at evening and other meetings.

Then again as to collecting results and comparing notes, we think science generally would be more aided than it is if there were more communication between kindred societies. It is, of course, a very general custom to exchange "Transactions," but we fear these are too frequently relegated to the library shelves, and forgotten, or little used, whereas, if it was the practice in every society to thoroughly note what is done by kindred societies, mutual assistance might often be obtained.

With regard to more intimate communion, we think federation of kindred societies very desirable, and in another page we print a suggestion for a Naturalists' Union for Lancashire. There can be no doubt that the union of societies studying kindred subjects can largely aid the progress of the studies engaged in, and we trust such federation may become more general.

In these directions then, and in other ways to which we may hereafter refer, do we consider that many societies that do not now materially aid science progress can be made useful in good work, but we especially wish to see in every society the whole body of members taking more active part than they usually do.

Local Museums.

IV.—Bristol.

THE Bristol Museum and Library was founded in the year 1868 by the amalgamation of two kindred societies, the Bristol Philosophical Institution and the Bristol Library. The Bristol Institution for the Advancement of Science, Literature, and the Fine Arts was established by the Philosophical Society, and inaugurated in the year 1823 by the opening of a museum of science and art; whilst the Bristol Library Society was founded as far back as 1772, and at the time of the amalgamation of the above associations possessed a collection of about 25,000 volumes. The union of the two societies having been decided upon, and a sum of something like £12,000 having been raised, the existing Museum buildings were erected at a cost, including the fittings, of over £20,000, and were completed and opened in the year 1871.

The Bristol Museum is a substantial structure, of well-blending Bath stone and yellow brick, in the Venetian style of architecture, and, although still incomplete as regards the carving, is an elegant if not an imposing edifice. It stands upon rising ground in a commanding position fronting Queen's Road, Clifton, within easy access of the City of Bristol, but sufficiently distant to escape most of its smoke. The Institution contains a Museum of Zoology, Geology, Archæology, and Ethnology, a Library and News Room, and a Lecture Theatre capable of seating 400 persons, with the usual smaller rooms and offices suitable for such a building. The Library is the largest in the West of England, containing some 50,000 volumes, and is especially rich in historical and topographical works. There is also a Scientific Library, of about 1,000 volumes, in charge of the Curator of the Museum.

The Museum is an oblong building of two stories. The arrangement is of the character known as the "large hall" system, and consists in the main of one large room or gallery on each floor. On entering from the arcade in front of the building the visitor finds himself within a spacious entrance hall. This hall is ornamented with some statuary, including "Eve at the Fountain," by E. H. Baily, R.A., a native of Bristol, and casts of some of the most famous classical works of art from Italy. It contains also a portrait of Rajah Ram Mohun Roy, "the first Hindu reformer," who resided and was buried in Bristol.

The Bristol Museum is primarily a museum of natural history. The lower gallery (100 feet by 40 feet) contains the higher vertebrata, viz., the Mammals and Birds; and to this room there is a glass-roofed annexe containing the Reptiles, Amphibia, and Fishes. Perhaps the best series in this department is the collection of Skeletons, especially of the higher groups of animals, with an interesting series of human skulls, and the Quadrumana, for which this Museum is largely indebted to donations from the Clifton Zoological Society. The upper compartment of the lower room, which was a later addition to the building, is devoted to Anthropology. The Ethnological collection, although strong in certain directions, is in the main of the ordinary character, and calls for no special mention. In Archæology, the most important series is that of Egyptian antiquities from Tanis, Naukratis, Tell Nebesheh, Tell Defenneh, Pithom, and other ancient sites in the Delta of the Nile, presented by the "Egypt Exploration Fund." In this part of the Museum is also placed for convenience a collection of medicinal articles derived from the vegetable kingdom, lent by the Bristol Pharmaceutical Association.

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The upper gallery—which is approached from the lower room and also from the entrance hall by flights of steps—consists of one large and well-proportioned room (100′ × 40′) devoted to the Invertebrata and to Palæontology, with an east wing (35′ × 30′) for the Mineralogical and Botanical collections. This room being lofty, with tall windows of clear glass on all sides, is very well illuminated, light, and airy; and in these important points will compare very favourably with the majority of museums in this country. The special scientific interest of this Museum undoubtedly lies here. The Geological collection is celebrated for the unique series of the teeth of *Ceratodi*, obtained from the rhoetic bone-bed at Aust-Cliff on-Severn by the indefatigable Higgins, and ably described by Miall in the publications of the Palæontographical Society; for the extensive series of inferior oolite fossils from Dundry, Dorset, and the Cotteswolds, including the Gasteropoda, so admirably described by Tawney in the Proceedings of the Bristol Naturalists' Society, and in greater detail by Hudleston in a monograph now publishing by the Palæontolographical Society; and for the remains of the great Deniosaurian reptiles, *Thecodontosaurus* and *Palæosaurus*, discovered by Riley and Stutchbury in the triassic dolomitic conglomerate near Bristol, and described by Huxley.

In this collection, too, will be found a very good carboniferous collection, noticeable for the fine series of teeth and spines of fishes, from the Clifton bone-bed, including several of Agassiz's figured types, for a very fine series of carboniferous limestone corals, and for an excellent series of coal plants, chiefly from the Radstock and South Wales coal-fields. The Liassic Saurians include the fine type specimens of *Plesiosaurus Conybeari, Sollas. P. megacephalus, stutch*, and a huge *Ichthyosaurus platyodon*, suspended so as to show both sides of the animal. There is an interesting collection of bones from the caves of the Mendip Hills, South Wales, and from a fissure in the mountain limestone on the neighbouring Durdham Down; also a fine series of upper greensand fossils from the Blackdown Hills, Devonshire. In this room is suspended a large (and also a small) scale map of the Bristol Coalfields, geologically surveyed by the late William Sanders, F.R.S., and adopted in its main outlines by the Government Survey—an enduring testimony of the indefatigable labours of a former Bristol geologist. There is an extensive and interesting general mineral collection, a large collection of rock specimens, and a well-mounted British herbarium.

In Zoology the most important of the invertebrate series is the mollusca, a group which is very fairly represented throughout; a collection of British lepidoptera, and an interesting series of specimens preserved in spirits from the Naples Biological Station. Unfortunately, for want of adequate facilities, the coleoptera and several of the other insect orders represented in the Museum collections are not at present fully exhibited.

The Natural History of the neighbourhood is illustrated by many rare and interesting specimens contained in the general collections, and by a few special series, viz., local minerals, rock specimens, and artificial mineral products, including fine specimens of Gloucestershire celestine, Clifton quartz, or "Clifton diamonds" as they are sometimes called, and jaspideous agates from the trias conglomerates of the Mendip Hills, a neat series of local land and freshwater shells, and another of local wild bees.

The Museum is open to the public on week-days throughout the year from 10 a.m. to 6 p.m., or dusk in winter; admission, 2d. on Mondays, Thursdays, and Saturdays, 6d. on Tuesdays, Wednesdays, and Fridays. The Library is open to subscribers only.

When the scheme for the new British Museum and Library was started twenty years ago, it was intended that the Institution should have, as far as the maintenance of the proprietary principle would allow, a public character; and with this view it was proposed that the Museum should be open to the general public free of charge on certain days, and that students should be admitted to the Library either gratuitously or at a reduced subscription. It is a matter of regret that it has not been found practicable to give effect to these excellent intentions, and, as the Institution is not open in the evenings, its usefulness is practically confined to the leisured classes of society. It is a further matter of regret that the voluntary sources, on which this Institution mainly depends for its maintenance, have fallen off during recent years, so that the Bristol Museum and Library have not shown a proper development in accordance with the growth of science and literature. It is to be hoped that before very long there will be a "revival of scientific learning" in Bristol, and that a public spirit may be awakened in time to prevent the otherwise inevitable decadence of an Institution which has been built up by the generosity and self-sacrifice of many noble men, with which the names of Sir Humphry Davy and De la Beche, Conybeare and Carpenter, Coleridge and Southey, have been associated, and of which its inhabitants may justly be proud.

Theories of Mountain Formation.

By T. Mellard Reade, C.E., F.G.S., F.R.I.B.A.

Part III.

In concluding the last article I promised to explain in what way the illustrations given of the effects of expansion on various materials bears upon the origin of mountain ranges.

But before doing this I must ask the reader to pardon a little digression, as I wish to call attention to the discussion which took place at the Geological Section of the British Association on the 10th of September on Professor E. W. Claypole's paper entitled a *"Note on Some Recent Investigations into the Condition of the Interior of the Earth." This paper dwelt with the discovery of a "level-of-no-strain" in a cooling globe already explained in the first article.

It so happened that none of the men whose names are associated with this investigation were present, and as I was admittedly fortunate enough to be the first to announce the discovery† it may not be inappropriate for me to correct some of the misconceptions that seemed to prevail among the disputants. Professor Claypole said—"Of the actual existence of such a zone, after a careful study of these investigations, scarcely a doubt can be entertained," but suggested that the numerical calculations of the depth at which it now lies might be in error, as we have many examples of rocks being "forced up from a depth greatly exceeding this limit." The speakers who followed mostly contended that such a neutral zone, where the cooling produces neither compression nor extension, could have no existence, as there were examples in all quarters of the globe showing that rocks had been squeezed, contorted, and forced up from much greater depths. The President most emphatically wound up the discussion by declaring his utter disbelief in the existence of a "level-of-no-strain" in our earth, having arrived at this conviction through his geological experience, which told him that the deepest and oldest rocks were the most crushed and folded, whereas on the "level-of-no-strain" theory they ought to be the least disturbed.

These sentiments—for a good deal of it was geological sentiment and righteous indignation against mathematicians—caused me much amusement. Anyone may see for himself who takes the trouble to study my "Origin of Mountain Ranges" that similar geological arguments are therein used to show that mountain ranges have not been thrown up by compression induced by the earth's contraction, which compression, as is proved by the discovery of the level-of-no-strain in a cooling globe, does not even now affect the earth's crust below the depth of a few miles. This was, in fact, one of the many reasons which induced me to look for another origin for the earth-foldings distinguishing mountain regions.

*Reported in *Scientific News*, September 14th, p. 289.

† *Origin of Mountain Ranges*, chapter xi.

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The speakers referred to at the British Association, unconsciously begging the question, took it for granted that earth-foldings and contortions could be produced in no other way than on the shrinking-apple system, therefore the "level-of-no-strain" was a myth—an invention of the enemy, the mathematician and physicist.' Q.E.D. Let us now see if there is not a method of explaining these wonderful evidences of pressure found in mountain regions without invoking secular contraction as the direct cause, and in a way more consistent with geological facts, which, as I before said, must be our guide and court of appeal in forming theories of the earth.

As already pointed out, the effect of the deposition of sediment is to raise the temperature of the underlying rocks. For the sake of employing round figures in illustration, let us say the heat gradient or rise of temperature downwards in a given area of sedimentation is 100° per mile = 1° per 52·8 feet, then the accumulation of 10 miles in thickness of sediment would raise the temperature of the underlying rocks 1000°, the sediments themselves taking at the surface the mean yearly temperature of the locality say 50°, and at the base being 1000° hotter. The mean rise of temperature of the 10 miles of sediment would then be 500°.

Such a thickness of sediments may seem astounding to those who are unfamiliar with geological facts, but the most eminent geologists tell us that the combined thickness of the strata of many great mountain ranges reaches this limit. As such a depth is twice as great as any known part of the ocean, it may justly be inferred that the weight of the pile of detrital matter has helped to displace the foundation matter of the globe upon which it has been built.

The underlayers at some unknown depth in the earth have flowed laterally from the area of sedimentation outwards, but of the manner in which the surrounding rocks are affected we have as yet no direct geological evidence.

It must be understood that these operations of Nature take periods measured by millions of years, and during this time with increasing weight, heat, and chemical action, the unsolidified deposits get consolidated into beds of rock capable of withstanding considerable lateral stress. As they are solidifying they are increasing in temperature and exerting a lateral thrust which is buttressed by the surrounding rigid area of old rocks, while the beds themselves are kept from rising in folds by the weight of sediment with which they are loaded.

But not only are the sediments themselves affected by these internal stresses: the underlying old and rigid foundation rocks are subjected to still greater stresses, as their mean temperature has risen twice as much as that of the overlying sediments. In addition, they are less capable of being squeezed into a smaller compass.

We see, therefore, that all the rocks in the area of sedimentation are subject to two opposite forces—one of increasing expansion by heat, and the other of increasing and countervailing vertical pressure by loading. The piling up of the sediment at first proceeds at a more rapid rate than the mean rise of temperature of all the underlying crust of the earth due to the deposition of the imperfectly conducting covering of new rocks. The sediments themselves also become worse conductors of the outflowing heat of the globe, as they lose their water by pressure, wet rock being a much better conductor than dry rock, as conclusively proved by experiments in the laboratory.

To what extent, then, can mechanical pressure resist the tendency of rocks to increase in bulk by rise of temperature. We really have no satisfactory data to go upon as regards *cubical* expansion, but as regards *linear* expansion it is found that an increase of 14° Far. will expand wrought iron $\frac{1}{15,000}$, and steel $\frac{1}{13,000}$, while, on the other hand, one ton in weight per square inch of section will compress iron and steel to the same extent. A rod of rock 10 miles long (the thickness of our sediments) and one square inch in section would weigh about 30 tons. I am not aware of any experiments on the compression of rock within elastic limits having been made; but, for the sake of illustration, were the co-efficient the same for rock as wrought iron, a rise of temperature of 420° at the bottom would be required to balance the vertical weight and keep the length intact if the rod were placed on end. This illustration is merely given to enable the mind—however imperfectly—to grasp to some extent the nature of the forces to be dealt with. It is thus seen, if the preceding proposition be granted, that a time must come when the forces of expansion overcome those of weight. What will then happen?

Many geologists and physicists have speculated upon the effect of expansion upon the rocks of the earth's crust. It is a strange fact that almost all have considered only linear vertical expansion. A very little consideration will, however, serve to show that the rise of temperature of a given section of the earth's crust will expand it in three directions, that is, cubically, but as the lateral expansion in two directions is resisted by the surrounding areas, the tendency is for the increase of bulk to take place vertically, thus making the mean vertical rise of the whole heated area three times what would result from linear expansion alone.

But, as I have pointed out in Chapter IX. of the "Origin of Mountain Ranges," the increase of bulk of the heated area would tend to dispose itself along lines of weakness, so that instead of the mass being elevated over the whole area it would rise in ridges. I have satisfied myself of this by experiment, but to prove it in detail here would take too much space. Those who wish to be informed further had better consult the plates of the original work.

The greatest internal stresses will exist in the base of the deposits and the original underlying rocks, and those subject to the overlying weight and the enormous expansive force within them will flow like lead under a die. This is no fanciful statement, but one proved by geological investigation of the earth's crust, when it is seen that the most rigid rocks have been bent, folded, squeezed, lengthened, or thickened in the most extraordinary manner. But in the case of old massive gneisses or complexes composed of igneous rocks, it has sometimes happened that the yielding has been by shearing, whereby enormous masses of rock have been bodily shifted along fault planes, such as have been lately described by the Geological Survey as existing in the Highlands of Scotland. In other cases, as in the Appalachians, when folding could go no further, shearing has taken place in the same way. In this manner old formations have been piled upon younger ones in a way to deceive the eye of even the practised geologist, who thought he was looking upon a regular and natural sequence of rocks. Indeed, patches of rocks have been bodily shifted considerable distances, and it is only just lately that this fact has been fully recognised owing to the labours of many geologists, and the complicated structure of a typical mountain district is now in a fair way of being unravelled.

But it will no doubt be asked how can the small increase of bulk caused by expansion effect such tremendous results? The best answer to the question is by a calculation. I set no value on statements or theories involving *quantity* unless they be reduced to figures. The best way to prick a scientific bladder inflated by the theorist who despises numbers is to put it into figures. Were the author in every case to perform this for himself, many grand theories would never see the light, excepting of the fire!

Let us consider what increase of bulk would ensue from the heating to 1000° Fahr. of an area of the earth's crust, 500 miles by 500 miles, and 20 miles thick. Such a cubic mass is very much less than many areas which have been affected by sedimentation in the way already pointed out. The increase of bulk due to expansion would in round numbers amount to 52,000 cubic miles, which is not a bad material capital to begin our mountain building with.

It is sufficient to form a ridge of triangular section 500 miles long, 100 miles wide, and 2 miles high. Doubtless part of the heat energy will

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be consumed in helping to consolidate the deposits, and in other ways; but I am now considering only what an effective increase of 1000° Fahr. would amount to translated into cubic miles of rock. There are, of course, many intricate details and agencies that cannot be discussed in an article of limited scope, like the present one. When we come to consider the actual structure of known mountain ranges, it will be the time to inquire whether internal stresses by increase of bulk through expansion by heat can account for their characteristic forms and structure.

There is, however, another important principle which must not be overlooked. It is this: Every rise of temperature, however small, goes towards the lateral pushing up of mountain ridges. The rocky material by expansion is actually moved by slow degrees towards the *locus* of the mountain range; subsequent contraction cannot bring it back again any more than it can efface the ridging up of sheet lead caused by small increases of temperature already referred to, consequently the effects are cumulative. Contraction is the cause of a different set of phenomena, which will be considered in another article. One aspect of the question will be readily apprehended. It is this: The greatest stresses are by this theory the deepest seated, which accords with the facts insisted upon at the British Association discussion, and urged as fatal to the existence of a "level-of-no-strain" in the earth, namely, that the oldest and deepest-seated rocks generally show the most evidences of pressure. Such facts do not disprove the existence of a "level-of-no-strain" in the earth; they only show that we must look to another source than the contraction of the earth for the cause of mountain upheaval, and indicate that other forces come into play which obscure, if they do not obliterate, the mathematically-deduced effects of the contraction of a cooling globe.

Colour Blindness.

BEFORE the time of John Dalton, the distinguished chemist, whose development of the atomic theory has achieved his lasting reputation, the infirmity of the human eye, now known as achromatopsy, Daltonism, or, more generally, colour blindness, was practically an unheard-of ailment. Now, however, the subject of colour blindness is an all-important one, engaging the closest attention of a host of specialists, and justly meriting the attention of our National Assembly itself. It will be interesting, before proceeding to discuss the phenomena of colour blindness, to trace the various phases through which our knowledge of this dread infirmity has passed, before our present information, superficial as it no doubt yet is, has been attained. About the year 1790 John Dalton observed that the bloom of a species of *zonale* geranium, which appeared blue to him by daylight, had by candle-light assumed a brilliant scarlet. In vain his friends assured him that its colour was constant; that by day and candle-light the blooms were vivid red. He could not understand it, and was at last obliged to admit that his perceptions of colours were not as other men's were—that he was colour blind. His inquiring mind at once proceeded to prepare a diagnosis of his complaint. From his investigations he established the important fact that the sense of colour was not a necessary concomitant of the sense of sight—that a perfect appreciation of form and distance might exist side by side in the same individual, with an utter incapability of perceiving any difference between two distinct colours. Since the time of Dalton's researches much attention has been devoted to the subject, but it is only within the last twenty years that people have recognised, even partially, the fact that colour blindness is a subject of universal importance. Persons suffering from it are now debarred from pursuing, at least, two of the most responsible vocations of daily life, viz., navigating a ship and driving a locomotive.

The defect of colour blindness would seem to manifest itself in one of the following ways:—

I.—Total inability to discern any colour, properly so called, so that black and white (*i.e.*, light and shade) are the only variations of tint perceived.

II.—Inability to discriminate between the nicer shades of the more composite colours, such as browns, greys, and neutral tints.

III.—Inability to distinguish between the primary colours, red, blue, and yellow, or between green, purple, orange, and brown.

Total colour blindness would appear to be very rare, but, where it has been observed, it is generally accompanied, not only by distinct vision in other respects, but by a far greater power than ordinary of perceiving objects when they are but very faintly illuminated, varying degrees of luminosity evidently supplying the place of shades of colour in giving variety to the appearance of external objects.

The second variety of colour blindness—where the nicer shades of the more composite colours are mistaken—is very prevalent, most persons suffering from it in some degree or other, the male sex more than the female. This complaint is no doubt referable to imperfect cultivation of the sense of colour.

The third form is, however, the most important variety. In extreme cases there is no certainty as to any colour, but in less severe cases two colours, red and green, and generally red, green, olive, and brown, are not distinguished from each other. Red appears to be the colour the want of which may be said to characterise the colour blind. Yellow gives the least trouble to those not absolutely unconscious of colour, and clear blue, if well illuminated, is readily distinguished. The colour-blind eye seems to err in being incapable of analysing white light into any but two primary colours, neither of which is red, while the normal eye has no difficulty in decomposing light into the three elementary colours. Many scientists urge that there is no such thing as single blindness for red alone, or blue alone, or green alone, but that an individual blind to red is blind to its complementary colour green, and that a person colour blind to blue is blind also for yellow. This theory would reduce all but extreme cases of colour blindness to two, namely, blindness for red-green, and blindness for yellow-blue.

Of the population of the United Kingdom some one million, according to the latest statistics, which take three per cent. as the ratio afflicted, suffer from colour blindness. What a revelation! That there are dwelling among us those to whom Nature in her gayest and brightest aspects is unknown! To such persons the chromatic splendour of the rainbow, the deep green of the ocean, the damask of the rose, the purple of the heather that clothes our mountain sides and bleak moorlands, is a myth. To them a Titian, a Rubens, a Correggio, with all its wealth of harmonious colouring, is but a study in sepia. But to realise their condition is to them impossible, for *to know* that they are colour blind is to cease to be so.

In the majority of occupations it matters little whether a person is colour blind or not, but there are some callings, *i.e.*, those of a sailor or a railway man in particular, where a clear perception of colours is not only desirable but absolutely necessary.

Some eleven years ago the Board of Trade established a colour test in examinations for masters' and mates' certificates of competency in the British Mercantile Marine. The Board were led to this decision because of the serious consequences which might arise from an officer being unable to distinguish the colours of the flags and lights carried by vessels at sea. The test consists in placing coloured cards before the candidate, and he is required to select various colours named by the examiner. If he can do this he can read the coloured flag signals by means of which one ship speaks another. The crucial test, however, is his ability to distinguish red from green, and both from white; for if he can do this he will be able to follow the international rules for the prevention of collisions at sea. To test this he is taken into a darkened room, and asked to discriminate between red and green glasses with the light of a candle or lamp behind them. The red and green glasses are of the same colours as the "port" and "starboard" lights of a ship. Any

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candidate presenting himself for examination and not holding a certificate of competency is first tested in colours, and his inability to pass debars him from gaining a certificate for seamanship and navigation. Candidates already holding certificates of competency and failing to pass the colour test have their certificates endorsed—"Failed to pass the examination in colours."

The Board in 1880 also instituted a voluntary test, by which anyone on payment of a shilling fee can have his sense of colour tested. But they have not gone far enough; every youth before he is allowed to embrace a seafaring life should be examined as to whether he is colour blind or not. As the rule at present stands colour blindness is not discovered until the apprentice has served his term, and "goes up" for second mate's certificate. Then, and not till then, does the colour-blind one find that he must abandon the vocation of his heart, conscious of the fact that some of the best years of his life have been spent in pursuing a business for which physically he was never fitted. Further, for able-bodied seamen there is no *compulsory* test, it being perfectly optional whether a seaman has his sense of colour tested or not, so that the safety of a valuable ship and hundreds of lives are jeopardised very frequently through having a colour-blind seaman on the look-out.

But it is to our schools, those day nurseries of our youth, that we must turn for assistance in this great difficulty. The tests for colour blindness are so extremely simple that every lad in our day schools could be tested at least once a year, and certificates stating that the holder had a keen perception of colours, or otherwise, as the case might be, could be given to every youth who left school to follow a sailor's life. The consensus of opinion relative to colour blindness would appear to be that when the infirmity is congenital it is incurable, but when the affection is only slight, or is consequent upon some sickness, as typhoid fever or measles, much may be done by careful cultivation of the colour sense to repair the mischief. The Kindergarten system, now so largely introduced into our elementary schools, will, no doubt, tend much to improve the perception for colours among the rising generation; but it is not until a systematic method of testing at regular intervals obtains that we can hope to gain that acquaintance with the symptoms and phases of colour blindness so necessary to combat the infirmity successfully.

RICHARD HOLLAND.

Remarkable Landslip at Dartford.

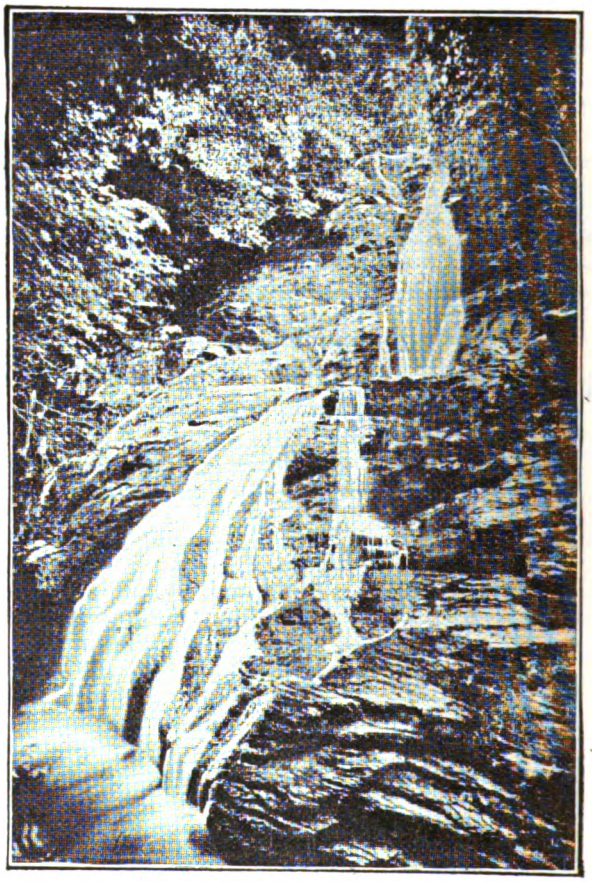
EARLY in August a landslip occurred at Lane's End, Darenth Wood, near Dartford, Kent, which resulted in considerable damage being done along the hill-side and the main road. A severe storm raged at the time, during which 3¼ inches of rain fell in 24 hours. The heaviest fall was between 10 and 11 p.m., when the rain, rushing down the side of the hill, swept a mass of sand, dislodged by the landslip (and in quantity estimated at 300 loads), a distance of 1¼ miles from the top of the hill to the Fox and Hounds Inn. A remarkable feature was the depth of the channel excavated in this short space of time along the public highway through Darenth Wood. The course was tortuous and varied in depth, being in one place 14 feet deep and 3 feet wide. The sides of the banks have fallen in 30 or 40 feet in places in consequence of the landslip, revealing an interesting section of the strata. The cause of the disaster is probably to be found in the fact of the loosening of the sand overlying a clay-bed by the excessively heavy rainfall on the night in question. The road was impassable for traffic until repaired. Some excellent photographs of the landslip have been taken by Mr. Biddle, photographer, of Dartford. The phenomenon is worthy of record, as showing the interesting effects of subærial denudation.

PROFESSOR CARNELLY, of University College, Dundee, has been appointed to the vacant chair of Chemistry in Aberdeen University.

Scientific Aspects of Health Resorts.

III.—Pitlochry, Perthshire.

PITLOCHRY has rapidly risen in favour with those who visit Scotland for change of air and scene. Situated in the midst of charming scenery, and within easy access, by lovely walks and drives, of many places of great interest, and with excellent accommodation at its hotels, its palatial hydropathic establishment, and pleasantly-situated private lodging houses, it offers many advantages to those who are seeking health, relaxation, or pleasure in a bracing and invigorating climate; whilst visitors interested in scientific pursuits will find it an excellent centre from which to study causes that have produced a wonderful combination of lake and river scenery, with lofty mountains and beautiful valleys.



THE BLACK SPOUT, PITLOCHRY.

For the purpose of preliminary observation and taking a general view of the configuration of the surrounding country, there are several eminences that offer standpoints for noting the physical characters of the district. Probably that one which affords the finest view is Ben-y-Vrackie, or the "Spreckled Mountain," which rises to a height of about 2,757 feet above sea-level. This mountain may be ascended direct from Pitlochry by way of Moulin, but there is a somewhat easier route from Killicrankie. From its summit may be observed a wide range of scenery, which presents numerous interesting features to the student of physiography. On a very clear day there may be seen the valley of the Garry, even to its higher reaches, with Loch Moraig in the far distance, whilst near to is the lower portion of the Garry valley and the Pass of Killicrankie, with the well-wooded slopes above it; also

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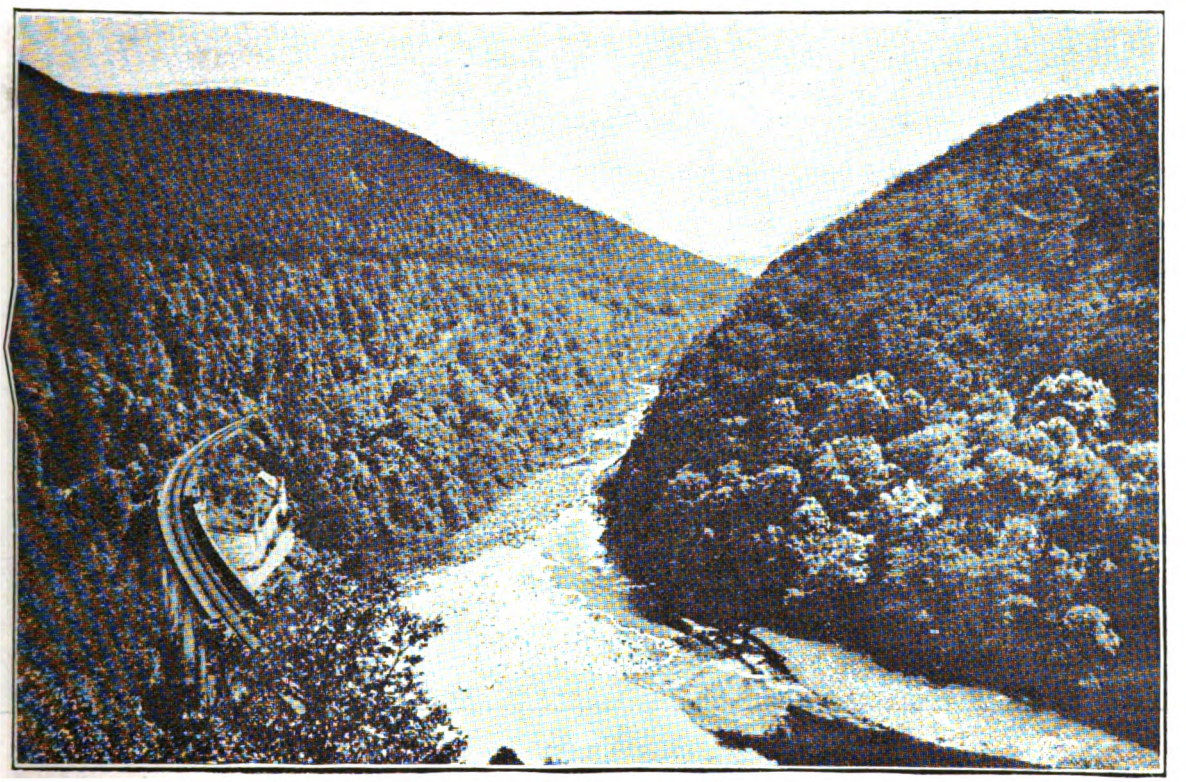
the valley of the Tummell from the Falls to the Loch, and from Loch Tummell to Loch Rannoch, and further on in the far distance the Buchaile Etive, "Shepherds of Glencoe," which guard the Pass of Glencoe. Then again may be seen the valley through which the Tummell flows to join the Tay, and the view is shut in in the distance by other mountains, which serve to indicate special points round about which disintegrating forces have been at work, but have left them still lofty and prominent features in the landscape.

The walk to the summit of Ben-y-Vrackie is somewhat toilsome, but the student of botany and other branches of natural history may find much to occupy the time of the ascent pleasantly and profitably; and may also do well to note the effects of different agents in wearing and breaking down the mountain surface.

Those who do not care for so long an ascent may view much of what is seen from Ben-y-Vrackie from the lower eminence of Craigower, or from the centre of the village by a walk of a little over a mile along the Dunkeld Road to the bridge over the Edradour burn, and thence by a path to the left alongside the burn. The fall affords an excellent opportunity of noting the cutting and chiselling effects of water, the rock at the topmost part of the fall being cut backwards to a considerable extent, and much of the water passes down this hollowed-out channel; whilst lower down, where the first fall of the water is broken, there is a fine example of hammer force as exerted by falling water, and lower still, the polishing effect of moving water is well seen. It may be advisable to mention here that mistakes are sometimes made in attempting to visit the Black Spout, as there are several falls in the course of the stream, and at least one other that deserves close attention.

The Pass of Killicrankie, of which also we give illustrations, likewise from photographs by Messrs. Wilson & Co., of Aberdeen, is a grand example of well wooded river scenery. It was through this Pass



The Queens' View, Pass of Killicrankie.

which may be ascended by way of Moulin, and from thence by a country road to the westward. The view from either of these mountains indicates that the scenery of the district is very largely due to water action—the natural drainage of mist and rain-water, the force of rivers, phenomena connected with lake formation, and the hammering and crushing, cutting and chiselling, grinding and polishing work of water acting under many circumstances.

In examining in this locality such actions as these, a visit may well be paid to a waterfall known as the "Sput Dubh," or "Black Spout," which Professor Blackie has made the subject of a short poem, and it certainly is worthy of his verse. This waterfall, of which we give an illustration on the preceding page, taken from a photograph by Messrs. G. W. Wilson & Co., of Aberdeen, may be reached easily in about ten or fifteen minutes by visitors to the Hydropathic, by a pleasant walk through the grounds of that establishment; that General Mackay led his soldiers on the 27th of July, 1689, previous to the Battle of Killicrankie, in which he was so disastrously defeated by the forces under Viscount Dundee, who, however, was himself killed. The site of the battle-field is not far from the top of the Pass.

Starting from that end of the Pass nearest the village of Killicrankie, one of the first points visited is what is termed the "Queen's View," from whence an excellent general view of the defile is obtained. And not far from here, at a point known as the "Soldier's Leap," the river Garry is closely hemmed in by a mass of rocks, where there is a magnificent rush of foaming water, and the rocks themselves, as may be seen in our illustration, show clearly many of the actions which moving water exerts on rock masses.

This Pass throughout is a fine example of the force of water in cutting out a river valley, and on every side may be seen instances of such work, some, indeed but trivial, but no less certain towards the

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general effect; but there are others of strongly marked character.

It is interesting to note in such spots how these water actions contribute, as of course they do, to the luxuriance of the vegetable growth, the water, not only by disintegrating the more rocky portions, and affording a continuous supply of mineral matters for plant food, but by aiding largely in the growth of mosses and other lowly forms which, by their decay, and the decay of the fallen leaves, also much aided by moisture, give plenty of organic constituents to the soil.

But, as regards the disintegrating power of water, probably the majority of visitors to such places never see them under conditions when most work is going on. The comparative quiet of the summer stream gives no idea of the rushing, crushing, brushing, hammering and tearing force of the winter floods. Neither can they judge how largely ordinary water work is aided by the disintegrating effects of frosts and other agencies not noticeable in the summer season of the year. But with the smaller stream there are often left wide stretches of water-worn stones, sand and shingles, and amongst these the naturalist may revel in great content in collecting numerous specimens of interest to him.

Leaving the Pass at the lower end of the pathway, it is well to pay a visit to the Bridge of Garry, close by, from which a magnificent view is obtained both up and down the river. And within an easy walk from this point are the Falls of Tummell, but we will refer to these and other parts of the river and lake systems of this part of Scotland in our next issue.

THE "SOLDIER'S LEAP," PASS OF KILLICRANKIE.

Our Portrait Gallery.

V.—THE LATE MR. RICHARD A. PROCTOR, B.A., F.R.A.S.

IN our last issue we had the melancholy duty of recording the death of Mr. RICHARD ANTHONY PROCTOR, the well known astronomer, scientific author, and editor of our contemporary *Knowledge*. In the prime of life, and in the midst of active work, Mr. PROCTOR fell a victim to one of those accidents of disease which it is as yet beyond the power even of science to be able to withstand.

The position held by him in the scientific world was almost unique. It is given to few men to possess, in the degree exhibited by Mr. PROCTOR, the ability for assimilating so large a store of knowledge in so varied a distribution of subjects, and to exercise at the same time the even more useful gift of exposition, which delighted alike those who read or listened to his teachings. Without the art of the expositor the labours of the original investigator would benefit but little the world at large; and, as it is, science owes much to the literary ability displayed by some of her votaries, who (whether original discoverers themselves or not) have been the means of spreading abroad an enlightened knowledge of, and appreciation for, the facts of science, and have thus been instrumental in re-inforcing the ranks of scientific workers.

In an age like the present, when the cry for utilitarianism is heard on every side, there is, no doubt, a danger that the paramount importance of theoretical or experimental science should be minimised if not altogether overlooked;

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THE LATE MR. RICHARD A. PROCTOR, B.A., F.R.A.S., &c.

From a Photograph by Messrs. Elliott and Fry, London.

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and we do not, therefore, counsel all scientific students to endeavour to emulate Mr. PROCTOR's wide range of study. The methods of science now invade so many fields of research that it is often necessary to proceed on the lines of the specialist, if it be desired to accomplish really useful, practical, and original work. Fortunately Mr. PROCTOR could claim that he had made many valuable original contributions to science, and especially to the science of Astronomy, in which he took a special interest. His astronomical charts, his determination of the rotation period of Mars, his correction of old errors relating to the transit of Venus, and his important series of papers on the distribution of stars and nebulæ, contributed to the Astronomical Society during the years 1866-82, are examples of original work which have a permanent value. His powers of simplifying complex mathematical problems and presenting them in an intelligible form to the non-mathematician also demanded abilities of a very high order. As an instance of his powers of application it may be stated that he copied 324,198 stars of Argelunder's Survey on an "equal-surface" projection chart—a task which was accomplished single handed, involving great labour. Most of this work will possibly be superseded by the new photographic chart of the heavens in course of preparation, but it will be difficult to excel the legibility and accuracy of the numerous maps and charts which he has produced from time to time.

But Mr. PROCTOR will be best remembered for his more popular writings, which ranged over many subjects—not alone of the scientific order, including the social, the political, the literary, and even the theological. His popular treatises were not mere collations from other sources, but the facts they contained were presented in a manner entirely Mr. PROCTOR's own, and could always be relied upon for accuracy. The art of original exposition of scientific truth is at least as honourable as the ability for original discovery; indeed, we do not know if the former does not demand as high an order of genius as the latter, though of a different kind. We are led to remark upon this with the more force from the unjust references which have sometimes been made in regard to Mr. PROCTOR's abilities for popular teaching, implying that educational aptitude required only rudimentary knowledge, and but little skill or originality of design for its effective performance.

Mr. PROCTOR's career is a record of hard work. Born at Chelsea in 1837, he received his early education at home, afterwards pursuing his studies at King's College, London, and at St. John's, Cambridge. He obtained the degree of B.A. in 1860, and appeared as 23rd in the Wranglers' list of that year. In 1866 he was elected Fellow of the Royal Astronomical Society, whereof in 1872 he became one of the Secretaries and Editor of the *Monthly Notices*, but resigned these offices in the following year, in order to undertake a lecturing tour in America. During the following years he lectured with remarkable success not only in this country but in the United States, and in the principal towns of the Australian colonies and New Zealand. Throughout his whole career he was a most prolific writer, advancing popular knowledge by constant articles in newspapers and periodicals (under various signatures), besides the numerous larger works which annually issued from his pen. Of these, the diversity was something remarkable. Their author was equally at home in discoursing upon the physical structure of the visible sidereal universe, or in expounding the "Laws of Chance," or applying his mathematical propensities to games of whist or chess.

His scientific works include—"Saturn and its System" (1865); "Handbook of the Stars;" "Constellation Seasons;" "Half Hours with the Telescope;" "Other Worlds than Ours" (1870); "The Sun;" "Light Science for Leisure Hours" (1871); "The Orbs Around Us" (1872); "The Moon" (1873); "Transits of Venus" (1874); "Universe and the Coming Transit;" "Geometry of Cycloids"—all of which were ancillary to one which was to have been his *magnum opus*, "Old and New Astronomy," of which only the first few parts have appeared, though, we understand, the work was practically completed before his death. Of his papers on more purely literary subjects (embodying, however, the processes and results of much scientific skill), we may mention the series in his own journal on "Shakespeare Self Drawn," his exposure of the nonsensical "Baconian" cipher of Mr. Donnelly, and his own version of the "Mystery of Edwin Drood"—"Dickens's Story Left Half Told"—as likely to live long in the memories of his readers.

With regard to Mr. PROCTOR's personal characteristics, the sketch contributed to the last number of *Knowledge* by his friends and literary coadjutors, Mr. Edward Clodd and Captain Noble, will be found to contain all that is necessary to show that in RICHARD A. PROCTOR the qualities of high-mindedness and earnest devotion to science pervaded his private life and public career.

O. W. J.

The Graphophone.

BY J. W. HOWARD.

THIS remarkable sound-producing machine is just now exciting much attention. It must not be confounded with Edison's phonograph, of which it is a development. The phonograph of 1877, although scientifically interesting, was far too imperfect in its articulation for any practical use, and its inventor himself, after trying in vain to improve upon it, abandoned the attempt, and turned his genius to other matters; and we might even now be without a practicable speaking machine but for the labours of Prof. Graham Bell, Dr. Chichester A. Bell, and Mr. Charles Sumner Tainter, of Washington, U.S.A. The first-named gentleman having been awarded the Volta Prize of 50,000f. by the French Government for the invention of the telephone, determined to devote that money to the interests of science, and, in connection with the other two, founded the "Volta" Laboratory Association, for the express purpose of investigating the recording, transmission, and reproduction of sound. Among other things, they took in hand the

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phonograph, and discovered the cause of its failure. They found that metal foil, which was used as the recording material, was unsuitable for the purpose, as its pliability caused it to pucker under the recording stylus, and so destroy the delicacy of the sound-record. They perceived that it was absolutely necessary that the record should be actually engraved in some solid resisting material, instead of being merely indented; they sought for such a substance, and found it in wax. They also discovered that much greater distinctness of articulation could be ensured (although at some sacrifice in loudness of tone) by making the sound-record as small as possible, and confining the sound by means of tubes attached to the listener's ears. These improvements they embodied in an entirely new machine, to which they gave the name of the graphophone, and it will be observed that the graphophone was not the outcome of a lucky accident or a happy inspiration on the part of an inventor, but it has been worked out on scientific principles, by means of carefully conducted experiments and inductive reasoning.

In the graphophone the recording tablet is made in the form of a hollow cardboard cylinder, covered with wax. This is placed in a small lathe, and rotated by means of a treadle, a simple but delicate governor serving to keep the speed of rotation absolutely constant. A balanced "recorder" is then hung upon a frame in contact with the cylinder, and spoken into by means of a mouth-piece and flexible tube. The "recorder" consists of a thin diaphragm of mica, carrying a steel point in its centre, which, vibrating under the influence of the sound, waves, ploughs out an undulating groove on the surface of the revolving cylinder, which thus becomes covered with fine spiral lines 160 to the inch, constituting the "sound-record." The recorder is then removed, and replaced by the "reproducer," a light feather of steel that travels along the grooves on the cylinder, transmits their undulations by means of a silken thread to a small mica diaphragm, which translates them afresh into sound-waves, and communicates them to the ears of the auditor through two india-rubber tubes.

The articulation of the graphophone is most perfect; instead of the metallic punchinello squeak of the old phonograph, we have clear articulation, in which every tone and shade in the speaker's voice can be recognised. The recording cylinder can be placed in a box, and sent by post to any part of the world, or filed away for reference. The author, journalist, reporter, or merchant can dictate his thoughts, reports, or correspondence into the machine, and then have them transcribed by pen or typewriter without further trouble to himself. Music can be recorded and preserved, and legal and other documents copied by the mere act of reading them over aloud; in fact, there is scarcely any limit to the usefulness of this machine, which not only records language, but speech.

Granite Quarrying in Ireland.

THE north-west of Ireland is a region of great geological and mineralogical importance. In this remote corner of our "sister isle" a great series of schistose rocks is developed, and forms what may be considered as a prolongation of the strata in the Highlands of Scotland. The rocks of this district (which have been the subject of repeated examinations by Sir Roderick Murchison, Professors Ramsay, Geikie, Hull, and more recently by Dr. Callaway) consist of granite, gneiss and chloritic or hornblendic schists, with crystalline limestones and immense masses of quartzites, all of which are of the highest interest viewed in the light of recent researches into these older metamorphic rocks.

The industrial wealth stored up in these rocky beds is considerable; but until lately little has been done to utilise it, although the opening-out of new industries in this part of Ireland would undoubtedly aid in great measure the solution of some of those questions which have been agitating the minds of politicians on both sides of the Irish Sea. So long ago as 1863, an elaborate report upon the "Constitution of the Granites of Donegal," which entered very fully into the useful characteristics possessed by these rocks, was presented to the British Association, and a later communication upon the subject by Dr. Haughton has appeared in the Quarterly Journal of the Geological Society, vol. xvii.

An important enterprise, by which it is hoped to turn the granitic wealth of Donegal to commercial advantage has lately been undertaken by Mr. Edmund Spargo, a well-known mining engineer, of Liverpool, which comprises the working of the extensive granite quarries belonging to the Marquis of Conyngham, at Dungloe. These quarries, covering an area of seventy square miles, are situated in close proximity to the sea, with direct shipping facilities, and have at hand an abundant supply of water-power. They yield stone which is stated to be of excellent quality, and particularly well suited for ornamental architecture; and is also adapted for use either in large massive blocks, smaller pieces for kerbs, channels, or crossings, or as ordinary "setts" for road metal, besides which, the chippings may be made into excellent material for macadam or the modern granite-faced pavement slabs. Amongst the geologists, chemists, engineers, and architects who have examined and reported very favourably upon the stone, are: Professor Hull, F.G.S., Mr. James Nancarrow, Mr. Philip Brannon, C.E., Mr. A. Norman Tate, F.I.C, F.G.S., and Mr. T. Mellard Reade, C.E., F.G.S.

From a scientific point of view, these granites are very interesting. The Donegal granite is composed of red orthoclase, oligoclase, quartz, black mica, and hornblende, the rock thus being coarse granular syenite, or "hornblendic granite." It frequently is found foliated and branching off in veins traversing the metamorphic schists. The colours of the stone are exceedingly rich and varied, leading from dark red and pink to mottled grey and even white granulite. Some varieties are highly porphyritic, others are of the variety known as "graphic" (with wavy markings), and the grain also varies between large and fine. The texture enables the stone to take a high polish, producing an effective appearance when used for purposes of decoration. It is well that this beautiful material should no longer be allowed to remain neglected, especially when the working of it is calculated to give an important stimulus in making serviceable the industrial resources of Ireland. Good practical work in such directions will do more to settle the Irish political problems than years of political agitation and parliamentary work.

Museum Notes.

A COMMITTEE has been formed in Newcastle-upon-Tyne to purchase, by subscription, and present to the Museum or to some institution in the town, a series of water-colour drawings of shells known as "Gibsone's Conches." The artist, George Gibsone, was an architect, who erected and managed for some years the first iron furnaces established on the Tyne—those of Leamington. The drawings consist of 1,965 separate sheets, measuring 13¾ in. by 9 in., and contain in all 7,260 delineations of 3,025 varieties of the Testaceæ. The Mayor of Newcastle and Archdeacon Martin are at the head of the movement.

LIVERPOOL FREE PUBLIC MUSEUM.—Commencing with the 1st of October, this Museum is to be open to the public every Monday evening from 7 o'clock until 10. The experiment of opening in the evening, in addition to the daytime, was tried some years ago, but was not attended with great success. Now, however, the committee hope for better results. A large number of persons cannot attend during the hours when the Museum is ordinarily open in the daytime, and the additional facilities now offered will certainly be a boon to many. At the inaugural evening meeting, the Rev. H. H. Higgins, M.A., delivered an interesting address, in which he recommended that visitors should devote a portion of their time at each visit to an examination of some special department, leaving something always fresh for subsequent Monday evenings. "The bane of utility in a public Museum," said Mr. Higgins, "is the delusion that to see it properly every room and gallery must be wandered through," the result being that people

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go away under the impression that they have "seen everything, and don't care to look again." A concise list of 15 departments was given, each of which would afford ample food for profitable study for one evening at least.

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CHADWICK MUSEUM, BOLTON.—The Town Council of Bolton have purchased for their Museum the valuable and extensive Castleton collection of palæontological and mineralogical specimens formed by the late Mr. Rooke Pennington. These have been arranged by Mr. Midgley, the curator, in the order in which the geological periods succeed each other, from the most recent to the oldest rocks in which any testimony of organic life has been traced. The collection is remarkably rich in several departments, such as ancient lead-mining implements used in North Derbyshire; remains from Derbyshire barrows or tumuli; cave bones from Cresswell Crags; stone, bronze, and bone implements used by the cave dwellers of Switzerland; and fish and saurian remains from the coal measures of Lancashire and Durham.

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A BIBLICAL MUSEUM has recently been formed in Serjeants' Inn, Fleet Street, London, which is open free to the public every day. Among the principal contents are casts of Assyrian bas-reliefs in the British Museum, of the Rosetta and Moabite stones, and of the Siloam inscription; models of ancient Jerusalem, of Herod's temple, and of ancient Athens; a series of coins illustrating the history of the Jews, and antiquities from Babylonia and Egypt, including several presented by the Egypt Exploration Fund and lastly, modern objects illustrating the ancient mode of life and the modern religious customs of Jews. The honorary curator of the Museum is the Rev. J. G. Kitchin.

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THE COMMERCIAL MUSEUM AT BRUSSELS.—Several specimens have recently been sent to this Museum from Medellin, in the Republic of Columbia, among them being samples of precious woods, and, in particular, of the *amamor* of Columbia, which is used for making canes in the handles of umbrellas. The same museum has also received specimens of gold and silver ore from Titiribi in the department of Antioquia. The *amamor* tree, which grows also in the Antilles, is beginning to be an article of export from these Islands to the United States, but that from Columbia brings a higher price in New York than that which comes from the West Indies.

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THE STUTTGART COMMERCIAL MUSEUM.—The *Export-Musterlager* of Stuttgardt is a permanent exhibition of native products, founded by a Wurtemburg Association of Merchants and Manufacturers, with a view to inform foreigners as to what may be procured in Wurtemburg, and the Society now includes 320 members belonging to different industries and trades. The number of visitors has increased from 170, of whom 26 were buyers, in 1882, to 210, of whom 196 were buyers, in 1887; and the total number of orders received, both by this establishment itself and by a similar one at Hamburg have risen from 90 in 1882 to 1,405 in 1887.

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THE COMMERCIAL MUSEUM AT TOKIO.—The French Chargé d'Affaires at Tokio reports as follows concerning this museum:—"The Tokio Museum occupies a large building of two storeys, in the European style, situate in the centre of the large Uyeno Park, that is to say, in the very centre of the favourite promenade of the people of Tokio. It is in intention rather instructive than commercial; its object, in fact, is to combine the collections of the products of all countries and all times, where the workmen and manufacturers may gather ideas applicable to art or to native industries. It is thus more an exhibition than a commercial museum properly so-called.

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Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between September 16th and October 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S., F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board:—

(*a*) Barometer	Highest (October 15th)	30·37	Inches.
,, ,,	Lowest (October 2nd)	29·23	,,
,, ,,	Mean	30·033	,,
,, ,,	,, for 21 years September	29·909	,,
,, ,,	,, ,, October	29·878	,,
Temperature	Highest (September 20th)	66·3	Deg. F.
,,	Lowest (October 2nd)	34·8	,,
,,	Mean	49·8	,,
,,	,, for 21 years September	56·3	,,
,,	,, ,, October	49·3	,,
,,	,, of Evaporation	46·3	,,
,,	,, ,, for 21 years September	52·9	,,
,,	,, ,, ,, October	46·8	,,
(*b*) Rainfall	Amount	1·047	Inches
,, ,,	,, Mean for 21 years September	3·484	,,
,, ,,	,, ,, ,, October	3·723	,,
,,	Number of Days on which Rain fell	13	
,,	Greatest fall in 24 Hours (October 1st)	0·230	Inches
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	6·4	
,,	,, ,, for 21 years September	6·5	
,,	,, ,, ,, October	7·1	
(*c*) Wind	Velocity Greatest (October 5th)	48	Miles.
,, ,,	,, Least (September 18th)	0	,,
,,	,, Mean Hourly	14·0	,,
,,	Greatest Pressure on Square Foot (Oct. 5, 5·35 a.m.)	28·4	Pounds.
,,	Direction at time of Greatest Pressure	WNW	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
55	99	137	21	30	165	140	72	1

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

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Bolton.

The improvement in the weather noted in the second week of September was continued till the 28th, eleven days consecutively being rainless. During this time the work of harvest progressed rapidly, and by the end of the month nearly all had been cleared. During the week ending September 21st the barometer was steady and pressure high, the mean being 30·289 in.; mean temperature 53·68°; sunshine 19 hours 52 minutes; and relative humidity 79%. From the 22nd to the end of the month the barometer kept high until the 28th, with a mean for the nine days of 30·092 in.; mean temperature variable, and dropping near 9° between 29th and 30th; sunshine 22 hours 9 minutes; rainfall 0·208 in.; and humidity 84%.

The weather during September, with the exception of the first week, was fine and mild and favourable to agriculture. The following are the monthly means or totals:—Barometer 30·177 in. (0·278 above average); corrected mean temperature 51·96° (1·66° above September, 1887, but slightly below average); relative humidity 81·2%; rainfall 1·636 in. (about one-third the average); and sunshine 83 hours 54 minutes, or 23% of possible amount.

October began with a remarkably abnormal state of weather, and continued severely cold for the first six days. On the 1st it was slightly foggy, rain and snow fell; on the 2nd the min. in the shade registered 4·4° of frost, the earth covered with hoar-frost, slight fog and rain; on the 3rd hoar-frost and rain; on the 4th rain and mist; on the 5th rain and heavy hail; and on the 6th snow-crystals fell. Pressure was very unsettled, and the mean for the week only 29·654 in.; min. in the shade registered more or less frost each day; the corrected mean temperature for the week was only 38 81°—about 10° below the average; the sun shone on six days with a total of 17 hours 54 minutes; rainfall 1·025 in.; humidity 81%. During the week ending October 14th a decided

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improvement has taken place alike in pressure and temperature. The barometer has been fairly steady with a mean of 30·096 in.; no frost; corrected mean temperature 44·29°; sunshine 15 hours 31 minutes on three days; rainfall 0·199 in. on the 12th; and relative humidity 86%.

W. W. Midgley, F.R.Met. S.

Met. Observatory, Bolton, October 16, 1888.

The Weather, September 15 to October 15, 1888.

On the 15th September, when our last notes ended, a band of high pressure extended over the kingdom, with barometer readings exceeding 30·0 in. at all places, and until the 27th of the month pressure varied but little, never falling below 30·0 in. A decided fall of the barometer commenced in the west on the 27th and continued till the 30th of October, when it was as low as 29·30 in. in the south of England. There was an increase of pressure on the 4th, but it gave way again in the north on the 5th, recovering again on the 6th, and had reached 30·10 in. all over England on the 7th. From then until the 11th anticyclonic conditions prevailed with readings above 30·0 in., when another depression appeared in the north, causing a barometric fall to 29·60 in. on the 12th. Afterwards there was a steady general increase in pressure, and on the 15th of October it ranged from 30·10 in. to 30·30 in over the British Isles. It will thus be seen that pressure has been high and steady during the month, except for the depression at the end of September and beginning of October, and another depression on the 11th and 12th of October.

	TEMPERATURE.					* Means for September.		RAINFALL.				
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Daily Max.	Daily Min.	Total Ins.	No of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Sep.* Ins.
Sheffield ...	69°	3rd	39°	27th	54°	—	—	0·89	10	0·33	24th	—
Spurn Head.	67°	5th	44°	30th	55°	—	—	2·34	11	0·54	10th	—
York	70°	13th	39°	30th	53°	63·3	47·3	1·14	10	0·29	10th	2·98
Barrow	65°	13th	40°	30th	54°	—	—	1·34	10	0·75	1st	—
Liverpool ...	67°	13th	42°	26th	55	61·2	50·9	0·68	12	0·14	1st	3·56
Holyhead ...	70°	14th	45°	9th	55	60·6	52·8	1·17	13	0·43	1st	3·35
Oxford	71°	15th	40°	12th	55	63·8	49·1	1·19	10	0·46	24th	2·91
London	74°	15th	42°	12th	57°	66·3	49·4	1·03	14	0·28	29th	2·59

* The means of Temperature and Rainfall for September are for 15 years.

The rainfall in September was much below the average at all places.

From the 15th to the 22nd of September the weather was finer and drier than it had been for a long time past. There was no rain at York, Barrow, Liverpool, London, or Oxford, and the rainfall over the kingdom generally was trifling. In the central parts of England there was fog and mist at times. During the following week, from the 22nd to the 29th, the weather was not so fair and bright. At the beginning of the week there were thunderstorms with hervy showers of rain in the south, and the depression at the end of the week caused unsettled, showery weather, with a decided fall in temperature. Sleet and hail fell in the north and east. There was rain on three days at Liverpool, two at York, Barrow, Holyhead, and London, and six at Oxford. In the first week of October the weather was unprecedently cold for the time of year, with severe snow storms in Scotland, and snow fell generally in the northern parts of England. In many parts of Yorkshire and Lincolnshire the growing corn could be seen standing in several inches of snow—a very unusual sight. Six degrees of frost were registered at York on the 2nd of October, and the nights were frosty at most places throughout the week. There was rain or snow on every day at Liverpool and Barrow, on six days at Holyhead, four at York, and three at Oxford and London. From October 8th to the 15th the weather was fair for the most part over England, but showery in the north and east of Scotland. Temperature was higher than in the preceding week, though there were night frosts in some of the midland and southern counties, the lowest temperature being twenty-seven degrees at Cambridge on the 8th. There was rain on five days at Holyhead, four at Liverpool, Barrow, and York, one in London and none at Oxford, and the fall was light at all places.

Astronomical Occurrences in November.

For many months past the sun has been almost entirely free from spots, but the minimum sun-spot period has now evidently passed, and spots are again appearing on the sun's surface.

The moon is new on the 4th at two minutes after midnight, attains her first quarter at 4-16 p.m. on the 10th, is full at 3-16 p.m. on the 18th, and enters her last quarter at 5-20 p.m. on the 26th. A 5th mag. star in Aquarius will be occulted by the moon at 5-9 p.m., on the 12th reappearing at 6-24 p.m. On the 19th there will be an occultation of a 5½ mag. star in Taurus at 9-57 p.m., reappearing at 10 9 p.m.

Mercury is a morning star, and may be seen on a clear morning low down near the S.E. horizon before sunrise after the middle of the month. Venus sets about 6 p.m., but, owing to its great south declination, is not well placed for observation. At the beginning of the month Saturn rises at 11 p.m,, and at 9-30 at the end of the month. Neptune is visible all night long, and is in opposition with the sun on the 22nd.

The shooting stars known as the "Leonids" may be looked for from the 12th to the 15th, but, as Leo does not rise till after 10 p.m,, they will be best seen after midnight.

The comet discovered by Mr. E. Barnard at the Lick Observatory, at the beginning of September, has increased so rapidly in brightness that it will probably become a conspicuous object this month. At the end of October it was in Orion, and the following ephemeris shows its position at the beginning of November:—

	H. M. S.		° ′
Nov. 1.—R A.	5 23 39.	Dec.	2-45 N.
,, 3.— ,,	5 14 24.	,,	2-10
,, 5.— ,,	5 4 28.	,,	1-33
,, 7.— ,,	3 53 50,	,,	0-55
,, 9.— ,,	4 42 31.	,,	0-16 N.

Its brightness on the latter date will be nine times as great as it was at the time of discovery.

Sheffield, October, 1888. E. Howarth, F.R.A.S.

Reviews.

Practical Metallurgy. By Alfred Roland Gower. [London: Chapman & Hall, Limited.]

Since the Science and Art Department introduced practical metallurgy as one of its subjects, teachers and students have often been at a loss for a suitable elementary text-book. The higher stages are provided for by such a work as Mitchell's "Practical Assaying," but this is scarcely applicable for elementary class work, and Mr. Gower's volume of 115 pages therefore makes its appearance opportunely. It will not only suit the requirements of the Science and Art Department, but will also prove of aid in private study. It is not, however, faultless; for instance, although Mr. Gower gives a table of atomic weights, he does not adopt them in his calculations, and there is an absence of completeness in the description of the analytical and metallurgical processes which may lead to incorrect results. There are also some errors in formula which no doubt the author will correct in any future edition. Taking it altogether, the work is one which will be found to be of service to teachers and students in elementary metallurgy. G. W. G.

"Inorganic Chemistry, Theoretical and Practical." An Elementary Text-Book, by William Jago, F.C.S. [Longman & Co.]

There seems reasonable grounds to fear that the multiplication of text-books on natural and physical science, at the present rate of production and reproduction, may become a serious perplexity to both teachers and students. But, at the same time, the almost numberless hand-books on these subjects issuing from the press would seem to indicate that among the community

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there is a healthy and increasing interest in matters scientific. There are few of these elementary manuals that have acquired greater popularity than the Elementary Text-Book on Inorganic Chemistry, by William Jago, F.C.S., Head Science Master of Brighton School of Science and Art. The present edition (the ninth) has been entirely re-written and greatly enlarged, and will be found to include not only the subject matter indicated in the syllabus of the Science and Art Department in Elementary Chemistry, but also those additional portions of the subject which are required for the Matriculation Examination of the University of London. The additions made to the present volume do not materially affect the scope of the book as a whole, whilst they do materially increase its value. As an elementary text-book it is simple, clear, and practical, and well suited for beginners.

W. D. H. D.

New and Forthcoming Works on Science.

AMONGST the announcements of forthcoming scientific works, we may mention the following :—

Exercises in Quantitative Chemical Analysis, by Professor Dittmar, LL.D. (Edin.), containing also a short treatise on Gas Analysis. Glasgow : William Hodge & Co. 318 pp. Illustrated. 10/6.

PROFESSOR BOULGER, the author of *Familiar Trees*, is engaged upon a new work entitled *The Uses of Plants*, which will shortly be published by Messrs. Roper & Drowley.

A WELL-ILLUSTRATED account of *Tenerife and its Six Satellites*, from the pen of Mrs. Olivia M. Stone, has appeared. It is published in two volumes, each of which may be had separately. The first treats of Tenerife, Gomera, Hierro and Palma ; and the second is devoted to descriptions of Grand Canary, Fuerteventura and Lauzarote. (London : Marcus Ward & Co., Limited. 21/- per vol.)

MESSRS. GEO. PHILIP & SON announce a second edition of Mr. Horace Woodward's useful *Geology of England and Wales*. It is embellished with large geological map (22 in. × 17 in.), autotype plate, and 104 sections and pictorial illustrations. 670 pp. 18/-. Also, a new geological map of Vesuvius, by Dr. Johnson Lavis, F.G.S., the result of eight years' labour on the spot.

MESSRS. TRUBNER & Co. announce for early publication the third and concluding volume of a monograph on "South African Butterflies," by Roland Trimen, F.R.S., Curator of the Museum, Cape Town ; also "Water Analysis," by J. Alfred Wanklyn, M.R.C.S., and E. T. Chapman, M.C.C.S. ; "Air Analysis," by J. A. Wanklyn and W. J. Cooper ; and "Rocks and Soils : their Origin, Composition, and Characteristics—Chemical, Geological, and Agricultural," by Dr. H. E. Stockbridge, of the Imperial College of Agriculture, Sapporo, Japan.

A New Series of Thirty-six Charts of the Constellations, from the North Pole to between 35 and 40 Degrees of South Declination, by Arthur Cottam, F.R.A.S. These are drawn to a much larger scale than any modern star-maps. From the specimen chart "Cassiopeia," issued with the prospectus of this work, it is evident that no pains have been spared to make the charts an indispensable adjunct to the library of every student of astronomy. (London : Edward Stanford. £2 per set to subscribers.)

The Minerals of New South Wales, by Professor A. Liversidge, M.A., F.R.S., is the most complete work extant on the wonderful mineral resources of this interesting region, and gives the full history of the original discovery of gold in the Australian colonies. Several papers contributed by the author to learned societies are included in the appendix. An important feature is the addition of a large coloured map, which is the best we have seen. (London : Trubner & Co. 326 pp. Plates. 18/-.)

MESSRS. SWAN, SONNENSCHEIN & Co.'s announcements include an *Atlas of Fossil Conchology* (being the original steel plates in Brown's *Conchology*), with descriptive letterpress ; *The Naturalist in Siluria*, by Captain Mayne Reid ; *Land and Fresh Water Shells*, by Dr. J. W. Williams ; *An Introduction to Zoology*, by B. Lindsay ; and a cheaper edition of Professor Victor Heni's *Wanderings of Plants and Animals*, edited by J. S. Stallybrass.

THE following new additions to Lockwood's series will shortly appear :—*The Model Engineers' Handy-book ; The Clock Jobbers' Handy-book ;* and the *Cabinet Workers' Handy-book ;* all illustrated. A new text-book on *Practical Surveying*, by G. W. Usill, A.M.I., C.E., and *The Metallurgy of Gold*, by M. Eissler, a practical treatise on the metallurgical treatment of gold-bearing ores, including the processes of concentration and chlorination, and the assaying and refining of gold, will be published this year by Messrs. Crosby, Lockwood & Co.

A NEW edition of Darwin's *Coral Reefs*, shortly to be issued by Messrs. Smith, Elder & Co., will be welcomed at this time when public interest in the vexed question of the origin of coral reefs runs so high. The same publishers have in the press a new work by Miss Frances Power Cobbe, on *The Scientific Spirit of the Age : with an Essay on the Education of the Emotions.*

MESSRS. B. HARAM & Co., Liverpool, have issued the prospectus of a new *History of the Hundred of Wirral*, by Philip Sulley. Since the publication of Mortimer's *Wirral*, more than forty years ago, remarkable changes have occurred and great advances have been made in the development of the portion of Cheshire included in the peninsula of Wirral. The new "History" (which has appeared in the columns of the *Birkenhead Advertiser*), is a model of what a county history should be, and contains full notes of all archæological and scientific features. Special chapters have been added on the local geology by Mr. O. W. Jeffs, and on the Fauna and Flora of the Hundred by Mr. Walter Wardell, and the work will be illustrated by several fine plates, maps and plans. 450 pp., foolscap 4to. 12/6. Special *edition de luxe*, limited in number, 20/-.

Societies.

NATURAL HISTORY SOCIETY OF GLASGOW.—The first meeting of the winter session was held in the Society's rooms, 207, Bath Street, on Tuesday, 25th September, Mr. P. Ewing, Vice-President, in the chair. Mr. D. Pearson exhibited a living specimen of the Australian piping-crow (*Gymnorhinus tibicen*). The species belongs to a group of birds of Australasian distribution, readily distinguishable from the true *coroidæ* by the peculiar form of the nostrils, which are long, narrow, sunk in the substance of the bill, and usually quite exposed. The black and white plumage is rather handsome, and bears some resemblance to that of the magpie. The piping notes of the bird are not unmusical, and compare favourably with the song of most others of its tribe. In captivity it displays excellent powers of mimicry. Mr. J. Steel showed a glass jar with sea-water containing hundreds of the larval form of the common shore-crab (*Carcinus mænas*), and remarked that in the early stage of their development these creatures are pelagic rather than littoral as regards their haunts. Mr. H. McCulloch exhibited a specimen of *Goliathus cacicus*, a large and beautifully coloured beetle, from Old Calabar, Western Africa. Mr. J. J. F. X. King showed a series of specimens of *Œcetis notata*, a neuropteron recently captured by him on the Liffey, near Dublin. He stated that the insect occurs in various parts of England, but is new to the Irish fauna. Mr. D. B. Boyd made some remarks on *Smynthurus* and *Papirius*, two genera of Collembola or "spring-tails," and exhibited a series of

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illustrative specimens of these insects taken near West Kilbride, Ayrshire. He also showed fertile specimens of *Bartramia Halleriana* and *Fontinalis squamosa*, two mosses from the neighbourhood of Largs. Mr. T. King, Vice-President, showed an extensive collection of fungi from the district around Glasgow, including *Agaricus scobinaceus*, *A. platyphyllus*, and other species of more or less rarity. Mr. W. Stewart exhibited five species of *Peziza*, including two apparently new to the British flora. Rev. A. S. Wilson, M.A., B.Sc., read a paper on the dispersion of seeds and spores, in which he describes the various natural appliances for insuring the suitable distribution of these objects, and the means by which the dispersion is aided or effected. The paper was illustrated by diagrams and specimens.

LIVERPOOL GEOLOGICAL SOCIETY.—The annual meeting of this Society was held on the 9th September, the President, Mr. H. C. Beasley, in the chair. After the transaction of preliminary business, which included the announcement of several important donations to the library from American and foreign societies and others, the election of Mr. W. Goodall as ordinary member, and M. Auguste Daubree (Paris) and Dr. A. F. Renard (Brussels) as foreign corresponding members, the usual balloting for the Council took place. The president (Mr. Beasley) and ex-president (Mr. G. H. Morton, F.G.S.) do not retire this year. The remaining officers elected for the ensuing session were —Vice-president, Mr. F. P. Marrat; hon. treasurer, Mr. E. M. Hance, LL.B.; librarian, Mr. E. Foster; hon. secretary, Mr. W. Hewitt, B.Sc.; and members of the Council, Messrs. J. J. Fitzpatrick, C. Ricketts, F.G.S., T. Mellard Reade, F.G.S., O. W. Jeffs, and the Rev. S. Gasking, B.A. The following were nominated for elecction as foreign corresponding members:—M. J. Villanova-y-Piera (Madrid), Major-General N. von Kokscharow (St. Petersburg), Baron von Richthofen (Berlin), and Dr. Albert Heim (Zurich).

The President, in his annual address, dealt in a very graphic and interesting manner with the geology of the district around Liverpool. After congratulating the society on the work of the last twelve months, he proceeded to show that a large number of unsolved questions relating to our local geology awaited the attention of members of the society. There was, he said, no ground for the statement so often expressed in the past that the neighbourhood of Liverpool afforded few features of interest to those whose aim it is to investigate the strata upon which we live. On the contrary, Liverpool formed an admirable centre for geological field work, and was especially rich in faculties for the study of the glacial and post-glacial beds and the phenomena connected with them. In the triassic strata of Lancashire and Cheshire, again, there were abundant opportunities for studying a series of formations about which a great deal has been written, but which presented many points of interest still comparatively unworked. Having referred to the enormous lapse of time represented by the entirely unfossiliferous beds interposed in this district between the carboniferous rocks and the keuper, which would suffice for the development of considerable change in the fauna and flora, the President counselled further and more minute investigation of the keuper strata, with a view to the discovery of the fossilised remains of the bones of those animals whose footprints are found recorded in the rocks at Storeton and many other places in the district. So far no remains of the animals themselves had been found in local strata nearer than the keuper sandstone of Shropshire. As to the bunter rocks, there was little hope of any such remains being found. With regard to the bunter sandstone, the evidence seemed to favour a riverine rather than either marine, estuarine, or lacustrine origin, and certain points recently brought forward by Professor Bonney tended to support this theory. Throughout the pebble beds the pebbles are generally of a peculiar character, being well-rounded, and usually differing entirely in composition from rocks of local origin. At a section exposed on the west side of Hilbre Island a conglomerate bed of remarkable character was found, many of the pebbles in which appeared to have been derived from the carboniferous rocks. There had recently been some difference of opinion expressed as to the age of this bed, which the survey regarded as a part of the bunter, though it had lately been mentioned as a basement bed of the keuper. The speaker invited the attention of members to this interesting section, and proceeded to refer to several local indications of sandstone beds having been accumulated as æolian deposits by the action of wind. Attention was also drawn to the strata as exhibited at Flaybrick Hill, where the junction of the lower keuper and the upper bunter is well shown. The address concluded with an appeal for members to take advantage of the many opportunities constantly occuring in the opening of new railway and canal cuttings, borings for water, and other sections, a careful study of which would frequently be found to throw new light on what has been previously learnt as to the stratigraphy and physical features of the country around our homes.

Mr. Jeffs, in proposing a vote of thanks to the President for his address, instanced some points in local geology as being specially deserving of fuller investigation. Mr. G. H. Morton seconded the motion, and mentioned that he had obtained from the water-stones at Nottingham (a formation which is also represented at Liverpool) specimens of a triassic fish (*seminotus*), which might possibly be found in this neighbourhood by diligent research. Mr. T. Mellard Reade stated that one of the most promising fields of local investigation was to be found in the strata lying immediately below the glacial deposits. Several American geologists have recently examined some of the sections in the neighbourhood of Liverpool, which they pronounced of the highest interest. Mr. Marrat also supported the motion, and the proceedings then terminated.

HUDDERSFIELD BOARD SCHOOLS' NATURAL HISTORY SOCIETY.—This Society is of a somewhat novel character, but it is well calculated to create interest in science studies amongst the rising generation. It is open to the past and present scholars of the fifth, sixth, and seventh standards, and to pupil teachers of any elementary schools, and its members at present are chiefly children of from 12 to 16 years of age. Meetings are held on alternate Saturday evenings at 6-30 p.m. for lectures in the winter months, and on alternate Saturdays at 2-30 p.m. for rambles during the summer months. Each member is provided with a pocket note-book in which to record observations made in country walks, and there are rules against the wanton killing or injuring of any living creature, and concerning the taking of bird's eggs, and the feeding in winter time of wild birds. There is also a library open on Saturdays from 9-30 to 10-30 a.m., and prizes are offered for (1) the best collections of insects and pressed plants made during the year, (2) the best exhibits at the Flower Show, and (3) the best answers to questions upon the year's work at the classes. Mr. W. Robson, chairman of the School Board, is president, Mr. S. B. Tait, treasurer, and Mrs. H. Rawlings and Mr. S. L. Mosley, conductors of rambles and meetings. The sixth annual meeting was held in the large room of the Spring Grove School, on Saturday, October 13th, and was commenced by tea, provided gratis to members (for the annual subscription of 1/-). Over 100 sat down, and, after tea, the president took the chair and distributed the prizes, chiefly for exhibits at the Flower Show, but also for best notes on the lectures, and the best collection of pressed plants, &c. Several persons spoke of the good done by the Society, including Mr. Gaunt, clerk to the Board. The prizes consisted of natural history books, and cases of specimens, which had been selected by preference by the children. After the prize distribution, Mr. Mosley showed some lantern pictures, and gave descriptions of animals in the Zoological Gardens (London). Pieces of instrumental and vocal music were rendered by the children at intervals, and a thoroughly enjoyable evening was spent. Mr. Mosley (Beaumont Park Museum) will be glad to send a copy of rules, &c., to any teacher thinking of starting a similar Society, and would also be glad to be in communication with existing ones.

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LIVERPOOL MICROSCOPICAL SOCIETY.—At the October meeting of this Society, the president, Mr. A. Norman Tate, F.I.C., &c., in the chair, Mr. I. C. Thompson, F.L.S., F.R.M.S., was elected president for the year 1889. Mr. I. C. Thompson exhibited under the microscope, and made some remarks upon some remarkable and little known Cladocera, a genus of the Crustacea, which he had recently found at various depths in the Cumberland lakes. One of these, the *Leptodora hyalina*, is an exquisitely transparent creature, about a quarter to half an inch in length, and has the appearance when alive of a minute fragile glass canoe rapidly beating its way through the water; he found it in Grasmere, Easedale, and Thirlmere lakes, its presence in the latter possibly possessing some interest to Manchester water drinkers. The other forms Mr. Thompson exhibited were *Bythostrephes cederstromii*, *Bosmina longirostris* (an animal not uncommon in London drinking water), and *Hyalodaphnia Kathbergensis*, a most eccentric looking microscopical crustacean with an immense eye surmounted by a long pointed head, comically resembling a dunce's cap. Mr. Thompson strongly recommended to the members the study of the minute animal life of our lakes and ponds, as affording a rich field for research, and one in which a large amount of original work has yet to be done. The president afterwards made some remarks on "Microscopy as a special branch of Scientific study," in the course of which he said that microscopy was now more especially employed, either for amusement, recreative study, or as an adjunct to other scientific studies, and there was not usually a sufficient preliminary training in the knowledge of the principles on which the microscope was constructed, or in its manipulation, whereas there are so many details to be considered and worked out practically before the microscope could be used with advantage, that a special training in microscopy is highly desirable, and he advocated courses of such study in scientific colleges, and schools, and for all who took up the microscope for the purpose of research.

MANCHESTER MICROSCOPICAL SOCIETY.—This very flourishing Society held its first evening meeting of the winter session on October 11th, at the Grand Hotel. The meeting took the form of an exhibition and conversazione. Professor A. Milnes Marshall presided, and there were present about 500 members and friends. In addition to microscopical exhibits shown under a large number of microscopes, there were the following special exhibits:—Mr. W. H. Harris, Table Polariscope and objects; Mr. W. Leach, Table Polariscope showing Crystals, and New Miniature Cabinet Polariscope; Mr. J. R. Hardy, Cases of British and Foreign Curculionidæ (Weevils); Mr. H. Hyde, Skeleton Leaves; Mr. E. Halkyard, Collection of British Tunicates; Mr. W. Chaffers, Collection of Drawings of Foraminifera; Practical Demonstrations in the processes of preparation and mounting of objects, by Messrs. Mark L. Sykes, James Hunt, George Wilks, and Edward Ward. Mr. J. A. Furnival exhibited, by means of his lantern microscope, a number of objects prepared on microscope slides, principally the work of members of the Society; and Mr. E. P. Quinn gave a most interesting lecture on a "Vegetable Trap," of which we hope to give a fuller account in our next issue. Altogether the meeting was a most successful one, and showed that in Manchester microscopical science is thoroughly appreciated, and has very many ardent and successful workers.

Letters to the Editor.

PROPOSED NATURALISTS' UNION FOR LANCASHIRE.

SIR,—The interesting reports which appear in the columns of *Research* show that much is being done in the direction of investigation in natural history by the societies located in Liverpool. The same energy prevails in this city, for there are here, apart from the famous Literary and Philosophical Society, at least six other well-established societies—the Field Naturalists', Scientific Students', Microscopical, Cryptogamic, Conchological, and Lower Mosley Street Natural History Societies, numbering among them 500 or 600 members, perhaps many of whom are in the very front rank of scientific workers, and many others who, if not so well known, are none the less energetic. That much is being done by these societies no one will deny; but, unfortunately, there is a lack of unity, for, except in a general way, the work of one society is almost unknown to another, and even where this is obviated by the exchange of reports, dual membership, &c., the absence of a central controlling body causes much excellent work to be lost. Now can nothing be done to change this state of things? It has been done in Yorkshire, then why not in Lancashire? Cannot a society be established to do for this county what the Yorkshire Naturalists' Union has done for Yorkshire? Besides the great centres of Manchester and Liverpool, there are in Ashton, Oldham, Stalybridge, and other towns societies numbering hundreds of members, and hence it would appear that all the materials are ready to hand for the formation of a union, which would not merely increase the personal enjoyment of its members but would undoubtedly consolidate already existing societies, and, in a more scientific, because more united, way than at present exists, would further the working out of the natural history of Lancashire. This thought has probably crossed the minds of most of the naturalists of this county, and merely awaits an opportunity for expression; and if, therefore, you would be good enough to allow the opinions of some of your readers to be recorded in your columns, a move might be made before next summer comes round in the direction of what probably all will allow is a "consummation devoutly to be wished."

FRED. E. BOWER.

48, Botham Street, Moss Side, Manchester.

[We consider the suggestion an excellent one, and shall be glad to find room for any correspondence on the subject.—ED. "RESEARCH."]

DRAGON FLIES.

SIR,—I desire to ask your numerous entomological readers if they would kindly furnish me with any assistance on the subject of Dragon Flies (*Odonata*). I contemplate shortly publishing a monograph of the British and European species, and am particularly desirous of obtaining reliable information relation to the metamorphoses of individual species from personal observation.

I am also very anxious to obtain specimens of dragon flies for figuring; I already possess a great number of species, but there are many others also which I have at present been unable to meet with. Any specimens, therefore, will be very acceptable, whether they are common or rare. The former will enable me to thoroughly investigate their geographical distribution, while the latter will be useful for figuring. All who send specimens will be publicly thanked in the work in question.

W. HARCOURT BATH.

Ladywood, Birmingham.

A SENSITIVE STIGMA.

SIR,—I noticed while examining some flowers of *Musk mimulus* that the stigmatic lobes are highly sensitive to touch. This sensitiveness may be noticed if the lower lobe of the stigma be touched with a blade of grass or with anything similar.

When the pistil arrives at maturity the lips of the stigma divide; the upper one retains its position, lying close to the inner and upper side of the corrolla, while the other projects out from it into the space at the entrance of the flower, so that an insect alighting upon the lower and most prominent part of the corrolla, would, on entering the tube, strike its head against the lower and projecting lip of the stigma, which when touched immediately closes up to the other. I believe by this

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admirable arrangement it secures what pollen may have been unconsciously deposited upon it by the visiting insect, and, remaining withdrawn, allows the insect to retreat easily and unobstructed.

Neasdon. J. H. A. HICKS.

Jottings.

A COMMERCIAL information office has been lately established at Belgrade, and by means of it the Servian Minister of Commerce is endeavouring to affect beneficially the commerce and trade of Servia.

PHOTOGRAPHIC EXHIBITIONS are now the order of the day. A project is on foot for an exhibition this winter in Manchester which is to rival all previous efforts made in this direction in Liverpool, Glasgow, Nottingham, and other towns.

SCIENCE AND ART CLASSES AT WREXHAM.—At a meeting held on the 9th September, in the Guildhall, Wrexham, under the presidency of the Mayor, Alderman John Jones, it was decided, on the motion of Alderman W. E. Samuel, to promote classes in Wrexham in connection with the Science and Art Department, South Kensington.

NEW MEDICAL SCHOOL AT SHEFFIELD.--A meeting was held last month in Sheffield to open a new medical school that has been erected at a cost of about £6,000. The meeting was attended by many of the influential inhabitants of Sheffield and neighbourhood, and an address was delivered by Sir Andrew Clarke.

MISS FLORENCE MORSE, a young lady of twelve years, has made the ascent of Mont Blanc, in company with Messrs. Evans, Coggin, and Viegen. The ascent was made without breaking the journey for a night at the Grand Mulets, as is customary. The ascent was made partly with mules. As far as the juvenile climber is concerned, she has established a record.

DONATION TO THE YORKSHIRE COLLEGE.—Colonel North, of Eltham, Kent, has contributed a thousand guineas in support of the Engineering Department of the Yorkshire College. Colonel North, who is a native of Leeds, subscribed not long since £5,000 towards the cost of the proposed extension of the Leeds Infirmary.

A BUREAU of commercial information was established two years ago by the Vienna Chamber of Commerce to afford information respecting Russia, Italy, Turkey, the Danubian Countries, Spain, Portugal, South America, Africa, and Australia, with instructions to centralise all information concerning trade and industries in these several countries received through the reports from the various Austro-Hungarian consulates, and the Minister for Foreign Affairs for Austria has recently proposed to the Vienna Chamber of Commerce to extend to France, Germany, England, Belgium, and the United States the same system of information, so as to make it still more useful.

THAT there is hardly a single town in this country of any importance which has not its photographic club or society is in itself an unmistakable proof of the very general and widespread interest taken in photography by all classes, and almost each week brings us the news of the establishment of some new institution of the kind. As one indication of this social vitality comes the announcement that the Amateur Photographic Society at Shrewsbury has prospered so much of late that its field of operations has been definitely extended and a Shropshire Camera Club formed, of which Mr. E. Creswell Peele has been elected President, Mr. H. H. Hughes, Vice-President, and Mr. W. W. Naunton, Secretary. The Club is open to the enrolment of lady and gentleman members, more than forty names being already subscribed.

HULL is also to have a free library after all—not, however, at the cost of the ratepayers, who have thrice rejected the proposal at the poll—but by the munificence of Mr. Reckitt, who has intimated his intention of building and establishing a free library for the eastern portion of the borough. The cost of the building, books, and endowment will amount to about ten thousand pounds.

LIBRARY EXTENSION.—The extension of free libraries is always of importance to those interested in educational progress. We learn that Selkirk has adopted the Free Libraries Act by a large majority. This result was due to Mr. Craig Brown, who has fitted up the disused county prison as a public library and reading room, and presented it to the borough. On the other hand, the Inverness Free Library, which was started a few years ago, is a complete failure. The reading room has been closed, and the reference and lending library is now open for only two hours daily. It appears that upwards of eight hundred books are missing from the library, and that there is a debt of £726, besides the original cost of the building.

PRIZES FOR ART WORKMEN.—The Society of Arts offers prizes as follows:—1. Pottery (including porcelain and earthenware), the body any material, (*a*) thrown, not shaved—first prize, £5; second, £2; (*b*) shaved or turned—first prize, £5; second, £2. 2. Decoration, (*a*) modelled and glazed—first prize, £10; second, £5; third, £3. (*b*) Painted under glaze, and (*c*) enamel on the glaze; the prizes of the same value as in (*a*). 3. Stone salt-glazed ware, (*a*) plain, incised and glazed, (*b*) coloured or otherwise decorated—prizes the same as in No. 2. 2. Stone carving. The capital of a column with square, circular, or octagonal abacus, not to exceed twelve inches in width—prizes, £25, £15, £10, and £5. 3. Wrought iron grilles—prizes, £25, £15, and £5. 4. Goldsmiths' and silversmiths' work. A cup or sugar basin of beaten silver, chased or otherwise—prizes, £20 and £5, presented by the Goldsmiths' Company.

THE NEW LABORATORIES AT TRINITY COLLEGE, DUBLIN, are now open under the general direction of Professor Emerson Reynolds, and comprise general laboratories for instruction in elementary chemistry and quantitative and research work. All are fitted with every modern appliance, and are in every way very complete.

The Dinsmore Gas Making Process.

THIS new process, by which the products of coal distillation that in the ordinary process of gas making escape as tar are converted into permanent gas, is making successful progress, and is undoubtedly an important improvement that must considerably cheapen gas, and improve its quality. Amongst other places, it is now in use in that great centre of chemical industry—Widnes, and, regarding its working, the Gas Engineer (Mr. Carr), in his report to the Local Board, says "This process has been in continuous operation since the end of July last, during which period over four million feet of gas has been made. We are at present making from Aldwark Main Gas Coal, without any cannel, 13,000 feet of gas per ton, varying in quality from 20 to 24 candles. The quantity of tar used is about one half, or say six gallons per ton of coal carbonised." The chairman stated that this was against 10,500 feet of 17 candle gas made under the old process, in which cannel had also been used. Further, the gas contained less sulphur compounds, other than sulphuretted hydrogen, and was of a more permanent composition. In working the process, the top retorts or tar ducts had been found somewhat too small, and consequently not as much tar was converted as might have been, but with a modification to remedy this slight defect, it is expected to effect additions both in illuminating power and quantity of gas.

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Research:

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NOTICES.

☞ We are again unavoidably obliged to hold over the reports of several societies and other matters; but, as "*Research*" *is this month increased to the extent of four pages*, we hope in the future to find space for the different communications that may reach us.

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E. W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & Co. Price 3d., or by post, 4d. Annual Subscription 3s., or by post, 4s.

Remittances for Subscriptions should be made payable to E. O. WINDEL, care of C. Birchall, 32, Castle Street, Liverpool.

Remittances and Communications respecting Advertisements, should be addressed to C. BIRCHALL, 32, Castle Street, Liverpool.

Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

The Protest Against Examinations.

THE *Nineteenth Century* has done a real service by publishing the "Protest against the mischief to which the system of Competitive Examinations is running in this Country." It is high time that this system should be most carefully inquired into, and a firm stand taken against its many evils, which are not only doing much to make education in this country a positive sham, but are productive of much real mischief to the mental and physical conditions of our children and student population. In our October number we referred to the examination system as being, to a great extent, "a curse and hindrance to scientific progress," and we would now most cordially support the protest referred to above. Many are the abominations in the examinations in our public elementary schools, and in no way is this shown more clearly than in assessing the "payments on results" by the one yearly examination, extending over a few hours only, when teachers, pupils, and all connected with the school are in a state of feverish anxiety and excitement, not unfrequently intensified by the bad temper of the inspector, and in no condition to do proper justice to the teaching which has been imparted during the whole previous year. We wish the managers of our elementary schools, many of whom see this clearly, would speak out strongly against this system.

And as with our elementary schools, so is it with many other examinations in schools of all grades and classes, they are not calculated to test good serviceable knowledge and ascertain the capability of the student to put it to good useful purposes. Most of them are simply tests of memory, and even these are conducted under conditions of time and circumstances of mental worry and anxiety that prevent pupils from doing full justice to themselves or their teachers.

Then, again, the work of the examiners is far too often unsatisfactory. Many of the examiners are men not fitted by their previous training for the work of examination. They are often very poorly paid for the work done; they have not ample time or opportunity for examining the papers worked, and it is evident that in many cases these latter are what may be termed "rushed through" in such a rapid manner that the examination after all is nothing more than a very rough sorting process. Many bad students get through in this way, and many a good one is "plucked." And it is not an unfrequent practice, where the number of persons examined

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is great, for examiners to farm out papers to assistants who check them off in a very perfunctory manner at a miserable rate of remuneration, and these assistants are frequently persons with no real experience in the work of teaching, or sufficient knowledge of the subjects they deal with.

And what is true of written examinations is equally true respecting several of the so-called practical examinations—they are simply absurd in a really practical sense.

But the chief mischief is caused by setting up the examinations of the present day as the standard to teach by. The capabilities of pupils for their work in the world cannot be sufficiently studied and developed when they are more or less kept grinding and cramming for these miserable examination purposes, and in far too many schools it is the examination that is worked for, with its certificates and prizes, and really serviceable studies are neglected, and what is learnt is generally quickly forgotten after the examination is over.

And it is not only the pupils who suffer, but our teachers are deteriorated. It is the "crammer" now who makes his work pay best, and really good teachers are at a disadvantage.

For these and other weighty reasons, then, the present examination system deserves the strongest condemnation, and all true friends of education should bestir themselves to bring about an early and thorough change. We, probably, shall never do away with examinations altogether; but, if we must have them, let them be of a character very different to what most of them are now, and become tests of true knowledge and ability to put it to serviceable use.

It is not only in connection with our schools and colleges that this system is so mischievous, in the Civil Service, and other Government Departments, as well as in other important institutions, much harm is done by the present competitive examinations, and here again great reform is urgently needed. Let us hope it will come quickly.

Theories of Mountain Formation.

By T. Mellard Reade, C.E., F.G.S., F.R.I.B.A.

Part IV.

It will be understood from the principles enunciated in Part III. that the surface layers of the earth are unaffected by expansion; it is only as they become buried in sediment that increasing heat can affect them. On the other hand, what geological indications have we in them of the effects of the secular contraction of the globe? The contractionists point to the folds of the great mountain ranges, but these, as already shown, only occur in areas of sedimentation. It would certainly seem that the secular contraction of the earth, if capable of producing these effects, should not be confined to areas of great sedimentation. We should expect to find old rocks in areas of denudation also thrown into folds and mountain ranges. As a matter of fact, no instance can be pointed to of a mountain range which has been entirely formed of old rocks. Old rocks are *disclosed* by the denudation of a range, but these have been the "foundation stones" of the range itself.

If but one mountain range could be shown by the contractionists to have been produced without the aid of sedimentation, their theory would be founded on a sounder basis of induction than it is at present. But it will be said, "even admitting the view that you take of the effect of secular contraction, and the existence of a level-of-no-strain in a cooling globe, the compression of the under layers of the earth must have produced some geological effects." Secular contraction may have left its mark on the earth in some way not at present understood, and it will take a great deal of investigation of a less crude character than seems to satisfy some geologists, to settle this point. If, however, we consider that the layers of the earth in compression now—on the favourable supposition that the surface remains constant and unaltered except by such compression, which is the condition assumed in all the calculations of the depth of the level-of-no-strain—is at the maximum estimate under five miles, and the minimum under two miles deep, we get a clue to the absence of geological evidences of secular contraction. There are very few calculations of geological time—at all events by those who have studied geology—that put the earth's history at less than 100,000,000 years, my own calculations being much in excess of that figure;* but for the purposes of mathematics one important condition in the calculation of the level-of-no-strain has been omitted, and that is *denudation*. I have pointed out in the "Origin of Mountain Ranges" that this agency would go far towards obliterating the geological effects of secular contraction.

As a rule, those geologists who believe that the earth's corrugations result from the contraction of the earth's nucleus also contend that geological agencies, such as those producing denudation, were much more active in the early ages of our planet, in which case a greater thickness of the earth's crust must have been removed in a given time than what I am disposed to allow. Let us, however, take the low rate of denudation of 1 foot in 4,000 years.† Then, in 100,000,000 years, the denudation would amount to 25,000 feet, distributed evenly over the land areas of the globe. In mountain regions this figure would be exceeded many fold, as calculations are given by American geologists of denudations equal to, or exceeding, this that have taken place in late geological periods in particular areas of the United States.

My own opinion is that the denudation of the land areas of our globe since the dawn of geological history has vastly exceeded this figure, but as Mercutio in "Romeo and Juliet" says of his wound, "'Tis not so deep as a well, nor so wide as a church door; but 'tis enough, 'twill serve."

In round figures, five miles of denudation would equal the *maximum* calculation of the depth of the level-of-no-strain. What would be the effect of this conditioning agency on the position of the level-of-no-strain? In the absence of other antagonistic forces it would remove most of the evidences of compression produced by secular contraction in the outer rhind of the earth.

The problem is an exceedingly complex one, and to some extent involves the question of the permanence of continents and oceans; but even granting for the sake of argument what I do not believe is the fact, that continents have always been where they are now, the removal of this amount of rock would of itself lower the isogeotherms to the same extent. That is, if a layer of the earth situated five miles deep were denuded of its covering till it reached the surface, it would have its temperature lowered, contraction would take place, and the conditions upon which the calculations of the depth of the level-of-no-strain are made would be materially modified. On the other hand if, as I believe with Hutton, Lyell, and the older school of geologists, every portion of the surface of the globe has been at one time or another subject to denudation, and the total amount of material removed from one site to another is much in excess of the calculation given, the non-existence of corrugations traceable to secular contraction is not remarkable.

* Chemical Denudation in relation to geological time.

† See "Denudation of the two Americas."—*Presidential Address, Liverpool Geological Society*, 1884-5.

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It is impossible for me, within the limits of these papers, to go into details as to the way the folds of mountain ranges have been produced. I am compelled to refer the reader to my original work on the subject, and to the diagrams and examples therein. I may mention, however, that the lengths of the mountain folds measured along the courses of the beds and the reproduced denuded archs, are fallaceous as a test of the original lengths of the beds. In many cases the length of a bed has been increased by lateral squeezing, and often the arch has never extended over the mountain top. It has been broken and separated by the protrusion of the underlying beds.

But if expansion is produced by the rise of temperature induced by sedimentation, contraction will result from the lowering of temperature initiated by denudation. Do we find geological evidences of such contraction? will be the first question of the practical investigator. To which I answer yes; the phenomenon of normal faulting is due to contraction.

It is strange, but true, that the theorists who refer the corrugation of the earth's surface to secular contraction, pass over the difficulties presented by the existence of *normal faults* very lightly. The explanation generally offered is that they are fractures of the earth's crust produced by its sinking upon the cooling nucleus. This explanation is not very much more lucid than if we were to say they are due to the "convulsions of nature"—a fraudulent explanation that used to satisfy our forefathers. The sinking of the crust, if it be an explanation of the forcing up of mountaln ranges by lateral pressure, fails to explain normal faulting, which is a phenomenon of an opposite nature.

Yet normal faulting is one of the most important factors in geology. Mountain ranges do not exist everywhere; there are always extensive level and little-disturbed plains in connection with them, such as the plains of Central Europe and the American Prairies. It would however, be difficult to find a geological map in which the observer has had the opportunity of actually seeing the structure of the earth, which is not full of faults. Contorted regions, as a rule, possess fewer of these characteristic fractures than the more level plains. It may safely be said that the absence of faults in a geological map is more due to their obscuration by drift coverings than to their non-existence. Geological mappers, of course, do not put in what they cannot see or reasonably infer. In proof of this it is only necessary to point to the wonderful system of fracturing which is always delineated in coal regions, where the opportunities of examining the strata are far fuller than in other regions.

The distinguishing feature of normal faulting is that the "hade" or slope of the fault is in the direction of the downthrow. An earthslip in a cutting gives one a good notion of what has taken place, but faulting is, as a rule, sharper in the fracture and more regular. Many geologists have pointed out that it is "as if the strata had been drawn apart." If they have been drawn apart it is obvious it cannot have been done by the same cause which previousiy squeezed them together and ridged them up into mountains. Normal faulting is *posterior* to folding. The student of the subject may take up almost any geological section of folded strata, and he will find that normal faults cut through the folds, and that, as a rule, if the downthrow side were lifted up to the extent of the throw, the curves of the fold would be continuous.

It seems to me as plain as anything can be that the cause producing the folds could not produce the normal faults. What, then, do they result from?

The only cause we know of capable of drawing the strata apart is *contraction by cooling*. Here we have what we were looking for, namely, the effects of the sinking of the isogeotherms as opposed to the compression and mountain upheavals produced by their rise.

I have already explained that the upheaval of a mountain range by lateral pressure resulting from cubic expansion ends in the actual transference of materials to the *locus* of the range. When the internal energies have for the time exhausted themselves, and the isogeotherms sink, a *cubic contraction* takes place. The weight of the portion of the earth affected will allow of the existence of no cavities beyond a certain depth, consequently the strata have to accommodate themselves to the new conditions of space, which they do by shearing into wedge-like orms which, by gravitation, fit together again and close up the opening. It has been pointed out already that expansion by rise of temperature under sedimentary areas was conceived to be a geological agent by Babbage, Herschell, and Scrope, but as an explanation of mountain building it was left by them in a very crude form. The dynamical effects were not fully traced, and cubical expansion was unthought of. Great praise is due to Captain Hutton for the impetus he gave to the theory by supplying elements that were previously lacking in it. I am not aware, however, of the existence of any systematic theory of normal faulting before the one broached by me in the "Origin of Mountain Ranges" (Chapter viii.) Detached thoughts on the subject there have been, and it would not be difficult to prove that glimmerings of light have occurred to many without the illumination being sufficient to allow the observer to commit himself to anythtng like a complete generalisation.

That the theory here sketched out is gaining ground, and will continue to do so, we have good reason to believe.

Those who are interested in the question will do well to read a paper by Mr. W. J. McGee, of the United States Geological Survey, in the November number of the *Geological Magazine*.‡ It is evident that American geologists are moving in the direction of the explanations of the corrugations of the earth's surface herein advocated. It is unnecessary to quarrel over the exact amount of novelty of view to be awarded to this or that investigator. If the views gain credence slowly, so much the more stable are they likely to become.

Mr. McGee says—"A primary hypothesis ascribed the corrugation of the terrestrial crust to contraction of the interior of the earth, accompanying secular cooling more rapid than that of the exterior shell. The common conception of the mechanism of this process was familiarly illustrated by likening the corrugated globe to a withered apple, and the inequalities of the terrestrial surface to the wrinkles on the apple's skin; and to the surprise of most American geologists at least, this hypothesis has been prominently advocated within a year or two."

No account of mountain formation would be complete without some discussion of vulcanology. To this phase of the dynamics of the earth I propose to devote the next article.

The Enumeration of Qust-particles in the Air.

By Dr. McPherson, F.R.S.E.

ONE of the most wonderful discoveries of modern science is the enumeration of the particles of dust in the air. However clear the atmosphere appears to be, it is literally crammed with organic and inorganic particles. If the shutter of the room-window be all but closed on a sunny day, the sunbeams will be seen glancing in the lightened plane. The housekeeper carefully dusts the rooms, and leaves them with a feeling of satisfaction; but no sooner do you show her this than she imagines that she has omitted to dust that room. Thousands upon thousands of bright specks people the space between the window and the wall. Some of these are organic, full of germs; but most are inorganic, and are lifeless. The living nuclei may be the propagators of disease, the dead particles are only annoying. Well does the surgeon know the persistent power of the living germs to foster putrefaction; and the physician is too painfully aware of the disease-bearing particles which float in every breath. It is intensely interesting, then, to know something of their exact number, and the best methods of minimising their propagation.

‡ "Some Difficulties in Dynamical Geology." P. 493 *Geological Magazine*, November, 1888.

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The methods of ascertaining the number of organic germs are quite different from the method lately discovered for enumerating the inorganic particles. Of the former, Dr. P. F. Frankland's is the most accurate; of the latter, Mr. John Aitken's is the only one which has ever been seriously attempted. The principle of germination is adopted for enumerating the death-carriers; a marvellous principle, which we will afterwards describe, is made available for counting "the gay motes that people the sunbeam."

To determine the microbes in the air, Dr. Frankland employed glass tubes of about five inches in length and a quarter of an inch in diameter. One end of the tube is slightly constricted, and a plug of cotton, loosely packed, is pressed in at the other end until it reaches the constricted part. About an inch from this plug the tube is again constricted, so as to hold fast a plug of fine sugar or glass powder, which has been forced down the tube. This plug is supported in front and behind by a layer of glass-wool. About an inch from the open end the tube is again constricted, in order to form a support for the important plug which has to catch the germs as they are being drawn in by the aspirated air. The plug is made of a small quantity of glass-wool.

The tubes thus fitted are sterilised by being heated on three successive days, to a temperature of 320° Fahr. When ready, the tubes are placed in a sterilised box, to be carried away to the place where the air is to be tested. At the place of observation, the tube is carefully taken from the box, and is handled by the constricted end. That end is then attached by means of a piece of stout india-rubber tubing to a piece of lead tubing about ten feet long, which is clamped at this end to a retort stand. The other extremity of the lead tube is attached to an exhausting syringe, which is mounted on a rigid support placed upon the ground. By bending the lead tubing the glass experimental tube is brought into a horizontal position.

After each upward stroke of the exhausting syringe the operator waits until the pressure is equalised before making the down-stroke. In this way each stroke of the pump corresponds to the passage through the experimental tube of a definite quantity of the air, which is being examined. The number of strokes measures the volume of air aspirated, and the number of strokes per minute determines the degree of perviousness which the plugs possess. In Dr. Frankland's apparatus, described in the Transactions of the Royal Society, one stroke of the air-pump is equivalent to eighteen cubic inches. The volume of air aspirated is varied according to the number of micro-organisms supposed to be present, but with ordinary town air 60 strokes of the pump are found to be sufficient.

The experimental tubes are then carefully closed and returned to the box. Next begins the process of cultivation of the germs. For this purpose he employed flasks of carafe shape, and of about 20 cubic inches in volume. Each flask contained about half a cubic inch of gelatine-peptone; and was fitted with a sterilised cotton-wool stopper. An experimental tube is removed from the box by the constricted end. A scratch is made with a file about the middle of the tube; the tube is then carefully broken across at the scratch. The half of the tube with the one experimental plug is held between the thumb and first finger at the constricted part; the stopper of one of the flasks is removed; and the open end of the tube is held vertically over the mouth of the open flask, whilst the plug is carefully pushed down by means of a strong piece of sterilised copper wire. The stopper is again inserted, and the gelatine is agitated with the plug by means of a rotatory movement, until the plug is quite broken up. The flask is now held almost horizontally under a stream of water; and, by uniformly rotating it, an almost perfectly even film of gelatine is spread over its inner surface.

The flasks, when thus prepared, are allowed to remain for an hour in a cool place. They are then placed under a bell-jar, at about 70° Fahr., for four or five days. The counting process next begins. The surface of a flask is divided into segments by ink lines. The area of a segment can be easily determined. As the surface of the carafe is known, the proportion of the surface of the segment to that of the carafe is also known. The film of gelatine with cultivated germs from the aspirated air being uniform, the number of colonies after incubation which are counted on the segment bears the known proportion to the whole contents. It is quite easy, and remarkably accurate. Dr. Frankland found that when the second plug in the experimental tube was subjected to similar treatment, scarcely a colony was observable; this showed that the organisms are almost invariably arrested by the first plug. For ordinary purposes, therefore, a one-plug apparatus is sufficiently accurate. Among hundreds of his recorded experiments, he found that at St. Paul's Cathedral there were 30 colonies of micro-organisms in a cubic foot of air from the Golden Gallery, 120 colonies per cubic foot of air from the Stone Gallery, and 140 from the air of the Church yard.

But what about the inorganic particles which cannot be thus propagated and enlarged for easier detection? Mr. John Aitken, F.R.S.E., of Falkirk, has counted them. He has enlarged them by another process to enable him to enumerate them. He proved, some years ago, that without dust there can be no fogs, no mist, no rain. He showed this by forcing common air through a filter of cotton-wool into a glass receiver, and injecting steam into this closed vessel. There was no appearance of steam; there was no fog. When the steam is injected into a glass vessel containing ordinary air, the dense cloud is at once observed. Thus, particles of water—vapour require *solid* bodies on which to form fog. The fine particles of dust in the air act as free-surfaces for this purpose. When the dust-particles are small and numerous, fog is formed; when they are larger and fewer, mist or rain is the result.

On the principle that every fog-particle has enbosomed in it an invisible dust-particle, Mr. Aitken devised a most ingenious method for counting the number of dust-particles in a given volume of air. He diluted a definite small portion of common air with a fixed large quantity of filtered air, and allowed the mixture to be super-saturated by water-vapour. The few particles of dust in the diluted air seize the moisture, become visible in fine drops, fall on a divided plate, and are then counted by means of a magnifying glass.

His apparatus consisted of a common glass flask, of carafe shape, and flat-bottomed, about 32 cubic inches in contents. Into it he poured 3 cubic inches of distilled water. Through the air-tight stopper are passed two small tubes, at the end of one of which is attached a small square silver table, about ·16 square inch in surface. The flask is inverted, and the silver table is placed ·4 inch from the inverted bottom, so that the contents of air right above the table is ·064 cub. inch. The observing table has been previously divided into 100 equal squares. It is very highly polished; but the burnishing is done all in one direction so that during the observations it may appear dark when the fine mist particles glisten with the reflected light, in order that they may be easily counted. The tube to which this mirror is attached is connected with two stop-cocks, one of which can admit pure filtered air from one vessel and the other can admit small measured portions (·064 cub. in.) of the air to be examined. The other tube in the flask, whose extremity does not reach so high as the former, is connected with an air pump of 10 cubic inches capacity. Over the flask is placed a covering, coloured black in the inside. In the top of this cover is inserted a powerful magnifying glass, through which the mist-particles upon the silver table can be easily counted. A little to the side of this magnifier is an orifice in the cover, through which light is concentrated on the mirror. This light, again, has had to pass through a spherical globe of water in order to abstract the heat rays, which, otherwise, would vitiate the experiment.

Mr. Aitken thus performs his experiment with this apparatus. He first exhausts the air in the flask by means of the air-pump. Then he

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fills the exhausted flask with air which has been thoroughly freed from dust-particles. A portion of the air to be examined, ·064 cub. in. in contents, is next carefully introduced into the flask, to be diluted by the filtered air. By one stroke of the air-pump the 29 cubic inches of mixed air is expanded to 10 cubic inches more, in all 39 cubic inches. The diminished pressure allows the water-vapour to rise from the surface of the water in the flask or from the moistened walls. Thereupon he looks through the magnifying glass upon the mirror, and observes the mist-particles, which are being formed by the water-vapour attaching to the dust free-surfaces, fall upon the mirror. The thing is done. As these mist-particles last for a time, he counts the number on a single square here and there, and strikes the average number on a square. Suppose the average number upon one square were one, then on the plate there would be 100, and the 100 particles of dust are those in the ·064 cubic in. of diluted air right above the table. But as there are 39 cubic inches of air with which the ·064 cubic in. of air to be examined has been mixed, the number of dust-particles in ·064 cubic in. of that air is 60,000, and the number of dust-particles in a cubic inch of the air examined is about one million. By this method the number can be counted in any specimen of air.

From numerous experiments made by Mr. Aitken, he is able to give the dust-particles in a thousandth part of a cubic inch of the air examined. In outside air the number was 521, when the examination was made after a heavy rain-fall, and 2,119 when the air had been for some time dry. This shows a very marked difference of four to one, and this may yet be made available as a test of the state of the atmosphere, as a help to meteorological inquiry. In the vitiated air of his room, above 30,000 dust-particles were counted in the thousandth of a cubic inch. And when he examined the air rising from the flame of a Bunsen burner, he found about 500 millions in a cubic inch. He is, moreover, of opinion that these figures are under rather than over-stated. Verily the dust is numbered. This will account to some extent for the infinite divisibility of the particles of musk which scent a drawer for years without any sensible diminution in the weight of the whole. These methods of enumeration of dust-particles, both organic and inorganic, are among the greatest marvels of our day. We just wonder how, in breathing air, we escape so long without injury to the lungs and system.

The Great Krakatao Eruption.

THE long-expected report of the committee appointed by the Royal Society to inquire into the history of this great eruption, which occurred in August, 1883, has now appeared. The work is divided into five parts, and embraces a descriptive account of the eruption (without doubt the most stupendous volcanic outburst known within historical times), an essay on the nature and distribution of the ejected materials, by Professor J. W. Judd, F.R.S., papers on the air-waves and sounds caused by the eruption, prepared under the direction of Lieut.-General R. Strachey, F.R.S., on the seismic sea-waves, by Capt. Wharton, R.N., and on the unusual atmospheric phenomena observed in 1883-86, including coloured suns, twilight effects, coronal appearances, sky-haze, &c.

Professor Judd traces the history of Krakatao as far back as it is known. By means of a small map he shows Krakatao lying on the point of culmination of two lines of volcanic fissure which appear to traverse the district at right angles. Krakatao and the neighbouring islets are probably the wreck of what must originally have been a great volcanic mountain, with a circumference at sea-level of 25 miles, and a height of from 10,000 feet to 12,000 feet. At some unknown period the volcano became the scene of a series of eruptions, which, judging from the effects they have produced, must have been on even a far grander scale than that which five years ago attracted so much interest. The last great outbreak previous to that of 1883 seems to have been about 200 years ago. From then until about six or seven years ago there seems to have been no remarkable signs of activity on the part of Krakatao. May 20th, 1883, appears to have been the date of the beginning of the latest volcanic episode, which culminated in the series of terribly destructive explosions of August 26th and 27th. On the afternoon of August 26th the crisis was evidently approaching, and from the logs of various ships which were in the neighbourhood Mr. Judd is able to give a connected story of the events of August 26th and 27th. Explosion after explosion occurred, filling the air with dense vapour and pumice and dust, lit up by the glow from beneath and the lightning generated above. The theory that the infiltration of water, setting up enormous chemical activity, is the main cause of seismic manifestations has received considerable support. From the situation of Krakatao, a volcano emerging from the sea, situated at the meeting-point of two great fissures, this infiltration theory had necessarily to come under Mr. Judd's consideration. The result is that he repudiates it as untenable. Water, he shows, certainly did play an important part in the Krakatao explosions, but not directly by setting up chemical activity. The continued activity of Krakatao carrying away the sides of the craters brought their lips down to the water edge. The result was an inrush of an enormous quantity of sea water, the first effect of which was to chill the surface of the lava, and suppress for a time its copious ejections. But another effect was to imprison the gases which were being continuously generated, until in time these increased so enormously in the vast mass of lava that an explosion of almost unprecedented violence was the result. The acme of this complicated activity was reached about 10 a.m. of the 27th, which, as Mr. Judd puts it, eviscerated the island, threw up thousands of tons of stuff in all stages of comminution, mixed with watery vapour, to heights estimated at from 12 to 23 miles, and gave rise to the gigantic wave which swept away 37,000 people, and propagated itself as far as the English Channel. Two-thirds of the island were blown away during the eruption, sinking its centre far under the sea and filling up channels previously navigable. The missing mass of Krakatao, according to Capt. Wharton's estimate, was at least two hundred thousand million (200,000,000,000) cubic feet. The report, which forms a thick 4to volume and contains 40 maps and diagrams, besides two coloured plates of the red sunsets of 1883, is published by Trubner & Co.

Scientific Aspects of Health Resorts.

IV.—The Valley of the Tay.

IN our article on Pitlochry in last month's issue we mentioned some of the scenery on the Garry and Tummel, tributaries of the river Tay, and we wish now to refer still further to this river, which is one of the most interesting of all the rivers in this country. Its whole course, from its very sources to its outfall into the sea, is well worthy of note on account of its scenery and the many topics that it suggests for scientific discussion.

In referring to scenery and the causes that may have produced it we are actuated by a desire to see such inquiries taken up more generally by those who visit different localities for the sake of health, pleasure and relaxation. There is usually too much surface admiration of beautiful scenes and superficial inspection of natural phenomena, without any desire to study causes that have produced them, whereas, if these were noted, much pleasure and profit would be added to that usually experienced. The scenery of the Tay suggests many lines of inquiry. These are the several mechanical and chemical disintegrating effects of water in cutting out the beds of streams and rivers, and how these are aided by ordinary frost; evidences of glacial action in bygone periods, and how far such action and other denuding causes have tended to the present direction

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of the water drainage and formation of the land; the effects of the pounding up of water by narrow gorges and its release with reference to the formation of lakes, and other circumstances that may have tended to produce the numerous lochs on this river system; the transport of disintegrated matter and their deposit in relation to silting up lakes, formation of fertile valleys, estuarial deposits, &c.; the action of water in aiding the different forms of vegetable growth; the occurrence or absence from certain localities of certain forms of plant life; and many other inquiries into the special natural history of the district.

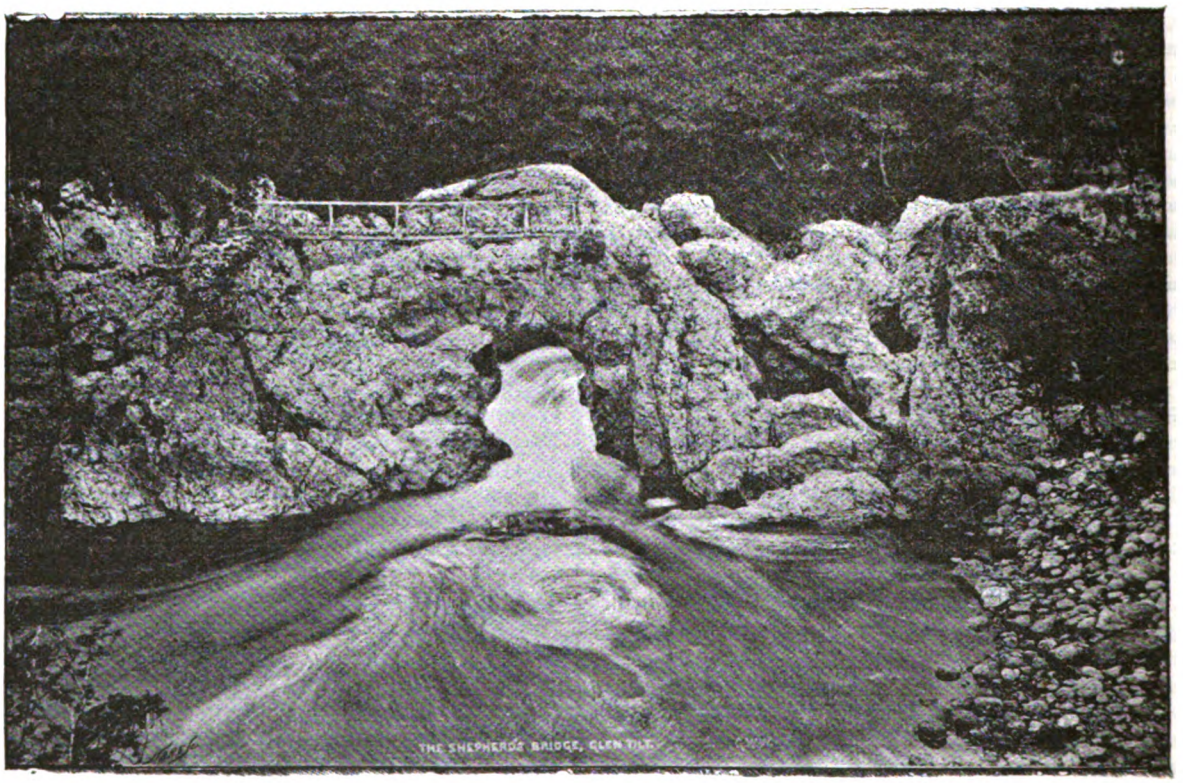
As regards the amount of water brought down to the sea, the Tay is the most important of our British rivers, its mean discharge being, according to measurements made by Dr. Anderson, 218,159 cubic feet per minute, which is greater in amount than that of the Thames

It begins to take its name as it flows out of Loch Tay, but is really formed by two great streams which rise amongst the Grampians on the borders of Perthshire and Argyleshire, and these have many tributaries in their course, the extent of surface drained being computed at from 2,396 to 2,750 square miles. The southern stream, which bears successively the names of the Fillan, Dochart, and Tay, and which passes through Loch Dochart and Loch Tay, rises on the side of Benloy, at the boundary of Killin with Argyleshire, about 7 miles N.N.W. of the head of Loch Lomond. The northern stream rises about 18 to 20 miles N.N.W. of the Fillan, and bears the names of the Gauir, Rannoch, and Tummel. The entire length of the course of the Tay, jointly as a river and an estuary, is said to be "if measured from the head of the Gauir, 118 miles, or from the head of the Fillan, 115 miles, but if measured along its channel from either of these remote sources, between 160 and 200 miles," and it has been well remarked that its course is "an epitome of everything connected with the action of running water, the erosion of rocks, the transport of soil, and the changes of lakes and valleys."

The scenery is very diversified, the higher reaches of the tributaries exhibiting in some parts much wildness and grandeur, and, in others, narrow, umbrageous glens; whilst again, and notably in the lower reaches, there are exquisitely beautiful landscapes with fertile valleys bounded by well wooded and richly verdant mountain slopes. The several lochs through which the streams pass also show great diversity of lake scenery,

It is impossible, without occupying far more space than we have at disposal, to do more than allude to a few of the interesting spots in the course of this remarkable river system; but, bearing still in mind Pitlochry as a convenient centre, we may mention some places easily reached from there by comparatively short excursions.

Glen Tilt, a view in which we give in the foregoing picture, is well worthy of a visit. Its characteristics are its narrowness, great depth, and extreme prolongation, and with its lower end presenting scenes of great beauty, whilst its upper is an excessively wild, narrow valley, bounded on both sides by steep and lofty mountains. Through it runs the river Tilt, which issues from Loch Tilt amongst the Grampians, near where Perth, Inverness, and Aberdeen shires meet. This river oftentimes rushes with irresistible force, forming numerous rapids and cascades, and exhibiting many examples of the action of water in cutting out ravines and forcing its way against great obstacles. There may be also found by students of glacial action much that will afford them profitable study.



The Shepherd's Bridge, Glen Tilt.

As examples of phenomena connected with waterfalls, the Falls of Bruar, not far from Struan station, may be noted, and in walking up the glen to reach these falls the visitor will have an opportunity of observing some most charming natural scenery. The falls are three in number, the uppermost taking a leap of not less than 150 feet. At the lowest fall there is a natural bridge, evidently hollowed out by water action, and of the middle fall we give an illustration

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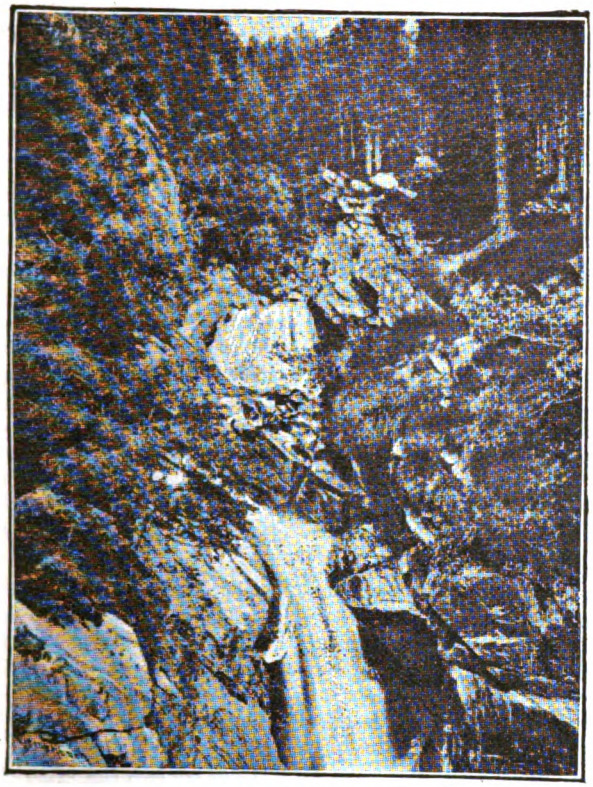
taken, as are the other illustrations in this article, from a photograph by Messrs. G. W. Wilson & Co., of Aberdeen. Burns has immortalised these falls in "*The Humble Petition of Bruar Water to the noble Duke of Athole*," and we cannot wonder at their exciting the



THE MIDDLE FALLS OF BRUAR.

genius of the poet when we note the scene of great beauty they and their surroundings present. But they are equally worthy the attention of the scientist. *(To be continued.)*

Ants.

By F. P. PASCOE, F.L.S.*

THE true ants, as distinguished from the white ants, belong to the *Hymenoptera*. In this country there are above 30 species, and about 1500 (André ii, 105) are known from other countries. Besides males and females there are asexual, always wingless, forms or neuters, and these three are generally so dissimilar that, in some instances, they have been placed, as in the *Dorylidæ*, in as many different genera. Neuters or workers are of two kinds—a major and a minor form. These neuters at first appeared to Darwin fatal to his theory of natural selection, but he believed this difficulty "is lessened or disappears if selection may be applied to the family as well as to individuals."

It is supposed that ants, like bees, possess the power of developing a given egg either into a queen or a worker. In the pupæ there are imaginal discs indicating the wings, as in males and females, but these are gradually atrophied before the perfect insect appears. These workers are sometimes fertile, but then they only produce males. The life of a male ant is short. The female, after the matrimonial flight, retires to her nest, which she does not again quit. It would appear that she is fertilized once for all. Sir John Lubbock's one (a *Formica fusca*) lived for nearly 15 years, and continued to lay fertile eggs. Sir John here throws out a most suggestive question—"Whether there is any multiplication of the spermatogenic cells?"

* Abstract of paper read before the Western Microscopical Club, London, November 5, 1888.

The intelligence of ants has always been a subject of admiration. Sir John Lubbock thinks that their mental powers differ from those of men less in kind as in degree, and that there are individual differences just as in men. Their predominant characters are industry and courage, although there are some both indolent and cowardly. Among the former are the slave-holders. Here we have the *Formica sanguinea*, a comparatively mild master. On the continent there is *Polyergus rufescens*, which wages fierce battle with the brown garden ant (*Formica fusca*), carrying off the larvæ and pupæ, taking care only of those that produce workers. Their marauding parties sometimes muster 2,000 strong, but it is only at such times that they show any vigour. At home they do not attend to their own young, and will even suffer themselves to die of starvation rather than help themselves.

There is much still to be learnt as to the senses of ants. Their sight is bad; the eyes, indeed, are sometimes wanting. In compound eyes the number of facets varies considerably, even in the same species, but the numbers do not seem to increase the power of vision. The simple eyes, or ocelli, resemble ours in that they see everything reversed, but Mr. Lowne suspects that "their function is the perception of the intensity in the direction of light." It seems certain that ants are deaf to the sounds we hear, but it is possible that they are not deaf to one another. Antennæ are generally supposed to be organs of hearing, but in ants the sense of smell, which is highly developed, appears to reside in those organs. They are also tactile organs, by which they are able to communicate with one another, and when friends long separated meet (they have a good memory) the antennæ play together as if in gladness.

By their rapid tapping on the abdomen of aphides those insects yield the honey, which the ant devours. The loves of the ants and the aphides have been long known. It is said of our yellow ants that they collect the eggs of certain aphides in the autumn, bring them into their nests, carefully tend them during the winter, and in the spring take them back to the plants from which they were brought.

There is a Mexican ant (*Myrmecocystus*) which is fed by others with honey until the abdomen is distended into an enormous sphere hundreds of times larger than its natural size; it is a depot, in fact, from which the honey may be distributed in time of need. Sir John Lubbock is acquainted with another species from South Australia, but of a different genus (*Camponotus*), similarly modified.

No little attention was excited some years ago when it was said that a Texan ant (*Podomyrmex barbatus*) was a veritable agriculturalist, deliberately clearing and preparing the soil, then sowing the seed of a grass in view of a future harvest. Dr. McCook, who has written from personal observation, is not satisfied with all that has been stated, but there is no doubt that large patches of ground from 7 to 12 feet in diameter are cleared and levelled, and that the desired grass crop "has the exclusive possession of the surface clearing." The clearances are surrounded by the dense vegetation of the plains—the yellow "needle-grass" or "ant-rice" (*Aristida oligantha*) as it is called—standing out distinctly from the surrounding herbage.

The sauba ant (*Œcodoma cephalotes*) is another celebrity. It is found all over tropical America. It is curious to see little bits of leaves slowly crossing a road, and to find on approaching that each is being carried by an ant, multitudes of which are ascending and descending a tree, which they will strip in a few hours.

The dread of the driver ant (*Anomma arcens*) is, says an African traveller, upon every living thing. "Their entrance into a house is soon known by the universal movement of rats, bats, mice, lizards, cock-roaches, and of the numerous vermin that invest our dwellings." These ants will destroy large animals if they cannot get away. Strangely enough they are blind. *Ecitons*, the driver ants of Brazil, "sets," says Mr. Bates, "the whole animal world in commotion." They travel in dense columns in countless thousands, but only in the thickest part of the forest. If the traveller gets amongst them they swarm up his legs

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with incredible rapidity, driving their jaws into his skin, then, doubling in its tail, it stings with all its might.

It is not fair to call the guests of ants parasites; they are amongst them as favourites, whom their hosts in times of danger will remove, leaving their own progeny to their fate. André gives a list of 584 species of insects living in association with ants.

Ants are mimicked by many members of other orders of insects as well as by spiders. The young of the *Mantis religiosa*, when emerging from their nest, would be taken by anyone for ants. Such resemblances are only accidental.

It only remains to say a few words on the white ants. They belong to the *Neuroptera*. A family of Termites, or white ants, consists of a wingless king and queen, workers and soldiers, always blind, and winged individuals who, after shedding their wings, become kings and queens of new colonies. The queen is always in a gravid state, laying for months together some thousand eggs a day, which the workers convey into the vast chambers composing a termitarium.

In tropical Africa they are looked upon as the worst of all vermin. They turn your house into match wood. Professor Drummond says they are nature's ploughmen in turning over and bringing the exhausted earth to the surface, as the earth worm does in Europe.

Ant hills—a distinctive feature in African scenery—are from 30 to 40 feet in diameter and 10 or 12 feet high. The furious rains of the tropics sooner or later beat them down and they crumble into dust, and are washed into distant valleys and down into the sea to form "the continents to be." Herodotus describes Egypt as the gift of the Nile.

Phonetics.

IT is not improbable that to most readers of *Research*, phonetics are known but little further than through the occasional cheap newspaper wit levelled at "Fonetik-nuz," &c. To these the word has an evil sound, and suggests advocacy of spelling reform, odd-looking letters, &c. I wish here to introduce this science to those who may not have hitherto given it much attention. Phonetics, physiology of speech, and physiology of sound are three names not really signifying the same, but each given in turn to the same science, as it presents itself in its different aspects to the investigator. A phonetician studies: (*a*) Of what sounds is human language composed; (*b*) how are these sounds produced; and (*c*) what is the best method of representing these sounds in writing and printing. It ought to be absolutely superfluous to remind anyone that the *sounds* of which a word is composed are not always the same as the letters with which it is written, and that these again are not one with the absurd names they bear. The word *knight* consists of four sounds, n a-i-t; it is written with six letters. The word *but* has three component sounds and three letters, but these are called bee, you, tea, which, if rapidly pronounced together, would make, not *but*, but what is usually written beauty. With these questions a phonetician, however, but little concerns himself. He knows they exist, he regrets that they exist: but, *as phonetician*, contents himself with hoping for better times.

In trying to remember what has been done in phonetics, the first name that rises up in an Englishman's mind is that of Henry Sweet; his Handbook of Phonetics ought to be in the possession of every student. However, though one of the leaders, he is but one of them, and his system of the vowels has many more or less determined opponents. The student who knows German *may* not remain without a careful study of Siever's, Trautmann's, Vietor's works, and all should know Melville Bell's "Visible Speech."* All these and many others have investigated and attempted to tabulate the sounds first of their own, then of other languages, and compared them among one another. No one will wonder that their systems differ; many will wonder, and all regret, that as yet each has a way of his own for transcribing the sounds he discusses. It is evident that in writing of the many various sounds and the slight, delicate differences between them, many more signs are needed than are provided by the usual alphabet. The sounds of *a* in *father*, *all*, *fate*; of the *e* in *the*, *pen*, *serene*, and so on, must all have their own fixed sign; nay, strictly speaking, the *p* of the French and the *p* of the English require, as different sounds, a different notation, &c.

But why all this labour? what is the result aimed at? To scientific readers it might seem superfluous to do more than show that there is a domain into which human knowledge has as yet but little penetrated. Language is, in the opinion of many, *the one* possession which separates man from the beasts, to which otherwise he is so closely related. Language has been scientifically studied, but a comparatively short time; however, that time is long, when compared to that since which linguists have turned their close attention to the manner wherein the sounds of which language is composed are produced. Language changes, language lives; the changes are regular, its life is not lawless, and the laws have been observed, and begun to be codified. But the question arises: Why *these* changes and no others? If this is to be answered, the reply must come from physiology as well as psychology, after a careful and complete investigation of the work done by the human organs of speech.

But not only scientific interest is claimed for phonetics; there is a direct practical gain in the help which a knowledge of phonetics gives the teacher of modern languages. The wretched inadequacy of the results usually obtained by the old methods, still almost exclusively followed in teaching children modern languages, is universally admitted. Only he who is wilfully blind does not see it. It is the phoneticians, it is (again they amongst many) men like Sweet, Vietor, &c., who have urged with all their might that the methods are bad, and begin at the wrong end: that the spoken language is *the* language, and the written one but a representation of it, dead without it. It is greatly due to their energy that some, a steadily-increasing number, have learned to see that the study of a modern language should begin with a careful practice in its sounds. A teacher must, they say, begin by teaching the sounds, and that not by mere endless repetition, but by means of intelligent explanation. Let us give one example. All English people who have ever wasted precious hours in their school days to learn French, which they forgot as soon as they possibly could, know the difficulty of pronouncing the French *u*. No amount of saying it for his pupils brought the teacher appreciably nearer his object—that his pupils should say it for him; and many, in consequence, accepted the "inevitable," and let their pupils pronounce *nature* = náttoor, and *pur* = poor or pyoor. But he who is trained phonetically lets his pupils practice the English *oo* and the English *ee*, and trains them to notice carefully how, for these two sounds, they put their lips and their tongue. He then is able, by a few adequate exercises, to make them combine the tongue position for the *ee* with the lip position for the *oo*, and the whole class has the reward for a few minutes' labour in producing a pure French *u*.

As everywhere, so here—before theorising must come the collecting of materials. Much has been done, but *much more* is wanted. Observers and independent investigators are wanted, who will carefully and accurately note down what they do when they speak: who will give a faithful and scientifically-accurate description of their own pronunciation, or of that in use in the district where they live or were born. No provincialism should be "corrected," no peculiarity of accent or utterance left unobserved. The wonderfully-accurate description of a German *patois* by Winteler forms one of the "classics" in

*It would be nothing less than absurd to attempt here a complete list even of the most important names. Yet perhaps even here Techmer's name, and his articles in the *Internationale Zeitschrift fur Allgemeine Sprachwissenschaft*, should not be passed over.

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phonetics. Everyone has his mouth always with him, and his ear he can train to observe. In train, in boat, on walk or excursion, he has almost all he wants with him, and few there are who do not daily hear things which they would know to appreciate, and of which they could tell others, if they once would learn to listen. The qualities of vowels, the greater or less energy of utterance, the length or shortness of syllables and of vowels, the gradual arising of variations in pronunciation—all these are of importance; the English dialects, not their vocabularies, but their pronunciation, are as yet a mine which is practically unworked. Who will come and work?

WILLEM S. LOGEMAN.

On a Vegetable Trap.

By E. P. QUINN.

[THE following is an abstract of the short lecture given by Mr. Quinn at the October meeting of the Manchester Microscopical Society, reported in our last issue.]

THE bladderwort is often found in the ponds abounding on the Cheshire side of Manchester. It is a floating plant with much dissected leaves, distinguished by the presence of little bladders, each about ¼-inch across, and open at the top, the apertures being closed with lids or valves that open inwards. Examined with a lens several stout branched hairs are visible, giving it an external appearance much like the well-known entomostracan, called the "water flea." In many bladders may be seen brownish specks, which, upon closer examination, will often prove to be entomostracans, larvæ of insects, or other small forms of animal life, either whole or disintegrated, and it is not unusual to see some of these alive and swimming about in the watery contents of the bladder.

The miscroscope reveals that the bladder is made up of two layers of cells; the outer cells are somewhat round, with fairly thick walls, the contents consisting of water with a thin lining of protoplasm and numerous green chlorophyll corpuscles, but between these are smaller cells, well filled with granular protoplasm, and projecting a little beyond the others. The inner layer consists of round cells with thin walls and intervening smaller ones with dense contents, and serving as basal cells, each supporting four unicellular hairs projecting into the watery contents of the bladder, two of these hairs being longer than the others. Towards the top the hairs are multicellular, the terminal cells being comparatively large and round. Near the opening, and upon the side opposite that to which the lid is hinged, the inner layer separates from the outer, forming a conspicuous projection. The lid also consists of two layers of cells much more minute than the others, and arranged concentrically, forming, when viewed from the top, a very beautiful microscopic object. This lid extends nearly as far as the projection on the opposite side, and is then folded under in the form of the letter ⊃, and in this infolded part the captured animals often get when attempting to escape, and thus they may be said to be held by a trap within a trap. Pressure on the lid with the end of a bristle depresses it until its edge reaches the projection or collar, but upon withdrawing the pressure the lid rises again. This would appear to leave a space around the margin of the valve through which the animal might be expected to escape, but observation shows that it cannot do this, and it was only after a bristle had been inserted into the bladder, and used as a lever to force the valve back, that an entomostracan managed to make its way out. The explanation seems to be that the infolded portion of the valve or lid acts as a spring pressing against the collar, and effectually preventing the egress of the creature within.

Thus, the microscopic structure, as well as the ineffectual attempts of the occupants to escape, prove it to be a vegetable trap splendidly adapted for the capture and retention of small aquatic animals.

The question arises—What induces the animals to enter this trap? My observations lead me to think that this entrance is not the result of mere accident. After walking over the transparent walls of the bladder, I have seen them enter in what appeared a deliberate manner; and, since careful examination of the bladders with high magnifying powers nearly always revealed the presence of infusorians existing inside to a much greater extent than in the surrounding water, and also since these same microscopic infusorians are the chief support of such forms of animal life as are usually found in the bladders, I cannot avoid inclining to the conclusion that these animals forced their way in for the same reason that a mouse enters a trap, and that is to partake of the food within.

Now, of what use can these captured animals be to the plant? The appearance of the dead and disintegrated animals, presenting a brown, broken up, granular appearance, one well known to the microscopist as indicative of decaying organic matter in water, does not favour the view of digestion or solution by the liquid within the bladder, and the examination of the contained liquid has not so far as I know, revealed the presence of any digestive ferment. Then, the length of time the animals can live in an active condition within the bladders—I have myself observed them quite lively after twenty-four hours' imprisonment—eventually dying apparently through sheer exhaustion, seems to show that the contents cannot be other than ordinary water.

Animals contain essentially the same chemical elements as plants, and by their decay give rise to soluble substances which, entering the soil, are absorbed by the fine hairs or fibrils covering the roots of growing plants, and to them serve as nutriment. Even without any special solvent, the water within the bladders must become highly charged with dissolved nutritious matter as the result of the organic decay of its enclosed animals, and the hairs attached to the inner surface of the bladders may be conceived as acting as organs of absorption, as in the case of root hairs. This would be especially valuable to a plant like the bladderwort, which, floating near the surface of the water, is devoid of roots, and has to subsist wholly by the absorption of nutriment dissolved in the water in which it grows. In proof of this contention, if we notice plants grown in pits where the water is comparatively pure, and others grown in a pond where the water is very stagnant and the bladders full of captured animals, we shall find in the latter case that not only are the plants much more robust, but are of a much darker colour. The microscopic appearance of the internal hairs show that in the latter case the protoplasm is far more abundant than in the former, and this I find to be the case with the cells forming the walls of the bladders as well; this greater density of the cell contents being much more apparent after soaking portions of the plant in absolute alcohol, and subsequently staining with iodine. In short, the consideration of these bladders show clearly that both structurally and functionally they may be regarded as true vegetable traps.

The Yorkshire Boulder Committee and its Work.

MR. S. A. ADAMSON, F.G.S., the indefatigable Secretary of the Leeds Geological Association, is also responsible for the important duties of secretary to the Committee for Recording the Erratic Blocks of Yorkshire. He has favoured us with a copy of the second year's report of this committee, from which we observe that its labours are by no means diminishing in either the scope of operation or the value of its researches. The object of this Committee is to "receive reports and conduct observations relative to the erratic blocks of Yorkshire, including particulars as to their position, height above the sea, lithological character, size and origin, and to work upon the same lines generally as the Boulder Committee of the British Association." The work done is of the highest importance, as evidenced by the copious lists of boulders appended to the report, which have met with the fullest acknowledgment at the hands of the practical geologists of the country. The reports are presented annually to the committee of the Geological Section of the British Association. A "boulder map" of Yorkshire has been prepared, on which are placed the true positions of

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the various erratics reported. The glacial geology of the county is evidently an exhaustive study, and further efforts will continue to be made to produce a survey of this part of the subject in as complete a manner as possible. The reports from the East and North Ridings appear to be, so far, the most detailed. In order that all unreported examples of erratic blocks may be duly scheduled, forms have been issued, which will be supplied upon application to the Secretary, 52, Wellclose Terrace, Leeds.

Yorkshire has shown a good example, which may be regarded as a type for laudable emulation on the part of other counties, and we cordially endorse Mr. Adamson's suggestion that if a similar committee were formed for the county of Lancashire, to collect observations on the glacial boulders and their distribution, the results to geological science could not fail to be beneficial. We should be glad to hear that this idea will bear fruit.

Our Portrait Gallery.

VI.—SIR JOHN LUBBOCK, BART., M.P., F.R.S., D.C.L., LL.D.

THERE are men of business so engrossed in their own special occupations that they neither find time for study nor for duties pertaining to public affairs in which, as citizens of the world, they should engage, and there are men of science and students of other subjects whose work and thoughts range only within similar narrow limits; but, luckily, there are others with energy, industry, and wide sympathies, who not only successfully pursue their ordinary callings, but who also *make* time and opportunity for much study and research. SIR JOHN LUBBOCK is certainly one of the latter class. As head of an old-established banking house he has not only conducted that business with energy and success, but has in several directions initiated and brought to successful issue important improvements in banking operations.

As a Member of Parliament he stands in the front rank of our most useful legislators, displaying energy, talent and business tact that have largely aided in the passing of numerous important measures; and as a magistrate and occupant of other public posts he has rendered many other valuable services to the community.

And whilst being thus active and useful in business and public capacities he has found time for the successful prosecution of many science studies, and is certainly one of our most eminent scientific men. It is of his work in this direction that we more especially wish to speak. He himself tells us, when writing on "Education" in his charming little book, entitled "The Pleasures of Life"—a book that reached its twelfth edition in a few months—"that whatever our occupation or profession in life may be, it is most desirable to create for ourselves some other special interest. In the choice of a subject every one should consult his own instincts and interests. I will not attempt to suggest whether it is better to pursue art or science; whether we should study the motes in the sunbeam, or the heavenly bodies themselves. Whatever may be the subject of our choice, we shall find enough, and more than enough, to repay the devotion of a life time. Life, no doubt, is paved with enjoyments, but we must all expect times of anxiety, of suffering, and of sorrow; and when these come it is an inestimable comfort to have some deep interest which will, at anyrate to some extent, enable us to escape from ourselves." And, as regards his own studies, he tells us that his own tastes have led him "mainly in the direction of Natural History and Archæology;" but he goes on to say—"If you love one science you cannot but feel intense interest in all," and in studying his scientific work it is not difficult to see that, whilst following out any one special line of inquiry, he has brought to bear upon it a mind well trained in many subjects. In fact, all his researches indicate that he possesses a mind thoroughly well stored with varied and well-digested knowledge, which he is able to use wherever serviceable in the work in which he is engaged.

SIR JOHN LUBBOCK was born on the 30th April, 1834, at 29, Eaton Square, London, and is the eldest son of the late Sir John William Lubbock, of Mitcham Grove, Surrey, and High Elms, Kent, who was himself head of the great banking house of Robarts, Lubbock & Co., and for a long period treasurer and vice-president of the Royal Society, and an authority as an astronomical writer. His mother was Harriet, daughter of Lieut.-Col. George Hotham, of York.

He received his earlier education at a private seminary kept by Mr. Waring, and afterwards proceeded to Eton, but owing to the sudden illness of his father's two partners he was removed from there at the age of fourteen to enter upon business at the bank in Lombard Street. He, however, spent much of his leisure at High Elms, the beautifully-situated family seat near Farnborough, in Kent, and devoted himself to the completion of his ordinary studies, and to natural history pursuits, for which at a very early age he had evinced great taste, which was carefully nurtured by his father, and from that time till now, notwithstanding his other numerous engagements, he has steadily pursued his scientific studies, and the results are a great monument to his untiring industry, more than one hundred memoirs having been contributed by him to the Royal, Linnæan, and other societies.

His researches in Zoology have been chiefly devoted to Anthropology on the one hand, and to the development, habits, and structure of the lower animals, chiefly insects and crustacea, on the other, and his discoveries have been numerous and valuable. He has devoted much attention to the connection between insects and plants, in regard to the fertilisation of the latter, and his researches on the habits of insects, such as ants, bees, and wasps, in which members of his family have aided him, have been especially fruitful in interesting results. A record of his labours in these directions is contained in his works entitled "Origin and Metamorphoses of Insects," "Wild Flowers Considered

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SIR JOHN LUBBOCK, PART., M.P., F.R.S., D.C.L., LL.D.

From a Photograph by Messrs. Elliott and Fry, London.

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in Relation to Insects," "Flowers, Fruits, and Leaves," "Ants, Bees, and Wasps," which latter forms a separate volume of the "International Science Series," and a volume of the same series, just published, entitled "The Senses of Animals." All these are not simply the record of ascertained facts and carefully-considered opinions, but are written in a pleasant, entertaining style, well calculated to lure the reader to further study. He has also written an elaborate treatise on one of the obscure groups of insects, under the title of a "Monograph of the Thysanura and Collembola" (*Ray Socy.*, *1873*.)

But, in addition to these natural history studies, SIR JOHN LUBBOCK has given great attention to Archæology. He was the first to describe to English readers those remarkable Danish shell mounds, remnants of the ancient Scandinavian savages, known as "Kjökkenmöddinger," or kitchen refuse heaps or "middens," which were first examined and described by Steenstrup and other Danish antiquaries. He further studied, in search of pre-historic remains, the gravels of the Somme from Amiens to the sea, also the bone caves of Dordogne, the lake dwellings of Switzerland, and other places of similar interest, and gave the results of his investigations in several memoirs in the *Natural History Review* and other journals, and eventually published them in a connected form under the title of "Pre-historic Times as Illustrated by Ancient Remains, and the Manners and Customs of Modern Savages." Then, again, he has written "The Origin of Civilization and the Primitive Condition of Man." And further, he has edited from the original manuscript Sven-Nilsson's treatise on "The Stone Age of Sweden."

In connection with Archæology SIR JOHN LUBBOCK was promoter of the "Ancient Monuments Bill," which, although thrown out by the House of Lords, was afterwards passed in a modified and less satisfactory manner by the Government in 1882.

In what we have already said we have by no means exhausted the record of his industry, for he has not only worked as an investigator and prolific author, he has lectured and discoursed on numerous occasions, and to audiences very different in character, and in this way has not only done much to interest those with scientific tastes, but to incite others to science studies also.

In his work in Parliament he has not forgotten science, but seems ever watchful how to make his own knowledge serviceable in promoting and aiding legislative measures. In one respect especially we know that he has been of great help to many scientific investigators. The leisure afforded by the additional holidays instituted by the Bank-Holiday Act has given to many a science-student leisure for enjoying his favourite pursuit. Those who know how eagerly the bank-holiday is looked forward to and utilised by a large number of earnest students of geology, botany, zoology and other subjects, can well understand how largely science has been aided by this one Act of Parliament, of which SIR JOHN LUBBOCK was the author, and we sincerely wish him success in his further efforts towards Compulsory Early Closing, believing that similar good results will follow.

The value of SIR JOHN LUBBOCK's scientific work has been testified to in many ways. His books have had ready sale, and been translated into many languages and reached many editions. His lectures and discourses have drawn large audiences, and been thoroughly well appreciated. He is member for the University of London, a high honour in itself. He is also Vice-Chancellor of that University; D.C.L. of Oxford; LL.D. of Cambridge, Edinburgh, and Dublin; M.D. of Wurzburg; a Trustee of the British Museum; Vice-President of the Royal Society; President of the Linnæan Society; and is also member and has held offices of many other societies. He was President of the British Association at their Jubilee meeting at York, when he delivered an address, which was afterwards printed under the title of "Fifty years of Science." In addition to all these and other honours, and as testifying on the one hand to his worth as a man of business, he is President of the Institute of Bankers, and President of the London Chamber of Commerce; and on the other to the attention he has given to educational matters, in which he takes great interest and is an authority, he is Principal of the Working Men's College.

We might add much to what we have already written if space allowed, but we trust we have shown what we desired to do, that SIR JOHN LUBBOCK's life has been throughout one of activity, earnestness, and well-doing, and that science has been greatly advanced by his labours.

A. N. T.

Death of Mr. Henry Lee.

THE recent death of Mr. Henry Lee will be lamented by all those who preserve a recollection of the admirable qualities displayed by this well-known naturalist during his popular curatorship of the Brighton Aquarium. This institution, in its palmy days, owed much to the accurate knowledge and experience of the deceased gentleman. Mr. Lee (who at the time of his death was about 60 years of age) was a frequent contributor to the daily and weekly press on natural history subjects, and several of his larger works have achieved a wide reputation. He was the author of a treatise on "The Octopus; or the Devil-Fish of Fiction and Fact," perhaps the most complete work extant upon the subject. The vexed question of the existence of the "great sea serpent" was frequently discussed by him. Mr. Lee inclined to the opinion that, without straining resemblances or casting a doubt upon narratives not proved to be erroneous, the various appearances of the supposed marine monster may be nearly all accounted for by the forms and habits of known animals. Two of the more popular of his works, written for and published by the authorities of the London Health Exhibition, were entitled respectively, "Sea Fables Explained" and "Sea Monsters Unmasked." These charmed all readers by their delightful style, which was at once popular and attractive, and yet so designed as to afford sound information on the wonders of the deep—a theme of which Henry Lee never tired, and upon which he always found something fresh and entertaining to relate.

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The Durham Salt District.

New Salt Field in the North of England.

By Edward Wilson, F.G.S.

Part I.

THIS salt field occupies the low-lying stretch of country in the south-east corner of the county of Durham bordering the Tees, and extends beneath the estuary of that river, and a portion (how much it is at present impossible to say) of North Yorksnire. Occupying for the most part an almost level alluvial plain, but little above the sea, this region presents no physical features of interest to the traveller through this part of England. It is a district, however, which in modern times has become celebrated for the rapid growth of the Cleveland iron industry, and the quite phenomenal rise of its metropolis, the town of Middlesborough. We may hope that the development of this new industry will give a fresh stimulus to the somewhat flagging prosperity of this important mineral centre.

The salt-beds of South Durham are associated with a thick series of red and green gypseous marls and interbedded red sandstones. These rocks, which are similar in character to those of the other British salt districts, belong also to the same geological series, known generally by the term New Red Sandstone, more precisely as the Keuper division of the Trias. Being of a comparatively soft and yielding nature, they have mouldered down under the wearing action of the river Tees, aided by its tributary streams and prolonged atmospheric waste, to a level very generally below that of the sea. During the "glacial epoch" this region came within the grinding action of a sheet of land-ice, as a result of which it became strewn over with a thick deposit of boulder-clay, and since then, during a general period of subsidence, it has been covered by alternating deposits of river alluvium and marine warp, according as the river or the sea obtained the mastery. Thus the solid rocks of the country are now concealed beneath an almost continuous cloak of superficial deposits, varying from 20 to 100 feet or more in thickness, and it is a rare thing to find the New Red Sandstone cropping up anywhere to the surface through the more recent accumulations.

It is not, therefore, surprising that the rock-salt of South Durham, which lies deep down in the rocks thus concealed, and nowhere shows any indications of its presence at the surface, should have remained for so long undiscovered, and that it should have been eventually found by accident. The first discovery was made in this way:—In the yea 1859 Messrs. Bolckow and Vaughan, of Middlesborough, being in want of water for steam and other purposes, at their ironworks, had a bole hole, 18 inches in diameter, put down to a depth of 1,200 feet. Although large supplies of water were met with in the more pervious strata penetrated by this boring, this water was so highly charged with the sulphate of lime as to be quite unfitted for the purposes for which it was required. In this exploration, however, after passing through 70 feet of superficial deposits of clay, gravel, and sand, and 1,136 feet of red sandstone and red and blue gypseous marls, a bed of rock-salt was unexpectedly struck at a depth of 1,206 feet from the surface, and proved to have a thickness of no less than 100 feet. Shortly after making this very important discovery, Messrs. Bolckow and Co. attempted to sink a shaft in order to work the rock-salt by a regular system of mining, but the influx of water was so considerable that the undertaking had for the time to be abandoned. For nearly twelve years after this nothing further was heard about Middlesborough salt. In the year 1874 Messrs. Bell Bros., the enterprising ironmasters of Port Clarence-on-Tees, considered the practicability of raising the salt to the surface by a different process to any which had previously been in use in this country, and which will be described presently. In the first place they employed the Diamond-Rock-Boring Company to put down an exploring hole near their ironworks at Port Clarence, on the north bank of the Tees, and about three-quarters of a mile from the Middlesborough boring. Here, after nearly two years' work, the rock-salt was reached at a rather less depth than on the south side of the river, viz., 1,127 feet, and of appreciably less, although still considerable, thickness. This boring was continued for a further depth of 150 feet in order to test the character of the underlying strata, and a second bed of rock salt, 14 feet thick, was found about 100 feet below the principal bed. Having proved the thick bed of rock-salt north of the Tees, Messrs. Bell sank a well to it, about a mile north of the Middlesborough boring, and subsequently a second well, a mile and a half north of the same place, established salt-pans, and commenced the manufacture of salt in the Durham district. The success of this firm soon brought other competitors into the field. In most of the subsequent explorations which have been made in the district the rock-salt has been found in workable thickness, but in a few noteworthy cases the bed has been found either too thin and poor for profitable working, or even entirely wanting. The Newcastle Chemical Works Company put down borings to a considerable depth on the north bank of the Tees, opposite Middlesborough. The saliferous beds of the Durham Trias were penetrated, and the upper series of the Magnesian Limestone proved to some depth, but no trace of rock salt was met with here, although this point was not more than a mile west of the wells at Middlesborough and Port Clarence, where the salt bed had been found in full force. Again, the Haverton Hill Salt Company proved the rock salt in five different wells, varying from 93 to 123 feet in thickness, near the place of that name, only three-quarters of a mile north of the Newcastle Company's unsuccessful exploration; but at Stone Marsh, about a mile west of Haverton Hill, the salt-rock was found to have dwindled down to an impure and worthless bed only nine feet thick. The Newcastle Chemical Company have since proved the salt bed in full force, and established wells on the Tees mouth shore, some little distance north of Messrs. Bell's saltworks, and Mr. Casebourne, of Hartlepool, has also proved the rock-salt at a depth of a little over 800 feet, near Greatham, a place about half-way between Middlesborough and Hartlepool. This last is the most northerly point at which the salt bed has yet been found in the Durham district. Last year a boring was commenced at Seaton Carew, two miles north of the Greatham well, and about the same distance south of West Hartlepool. No bed of rock-salt was met with in the New Red Sandstone at this point, although a brine spring was tapped in the underlying Magnesian Limestone, which, it is thought, may prove remunerative.* Several deep borings have also lately been made for water in the neighbourhood of West Hartlepool, in some of which the saliferous strata of the new red sandstone have been pierced, but in none of these has any rock-salt been found. Hence, it appears to be now pretty clearly established that the deposits of this mineral do not extend so far northwards, but that they die away in this direction somewhere between Greatham and Seaton Carew.

Successful explorations for rock-salt have also recently been conducted at several points on the south shore of the estuary of the Tees, amongst which may be mentioned the Cleveland Salt Company's well at the South Bank Ironworks, near Eston Junction, a little over two miles east of Middlesborough, a salt-well at the Imperial Ironworks, and a boring at North Ormesby, in the neighbourhood of that town.

The Durham salt-field has thus been proved to occupy an area of at least four miles by three, viz., from North Ormesby to Greatham, north and south, and from Haverton Hill to Eston Junction, east and west, or twelve square miles; and this estimate probably falls very far short of the total extent of country which it covers. Beneath the greater portion of this area, the chief salt bed has been found to maintain an average thickness of about 100 feet. When we consider

* This boring is of exceptional geological interest, because it furnishes us, for the first time, with a complete section of the magnesian limestone, here 878 feet in thickness, and because coal measures have been proved beneath the Permian rocks. The boring has now reached a depth of over 1,800 feet, and is being proceeded with in search of coal.

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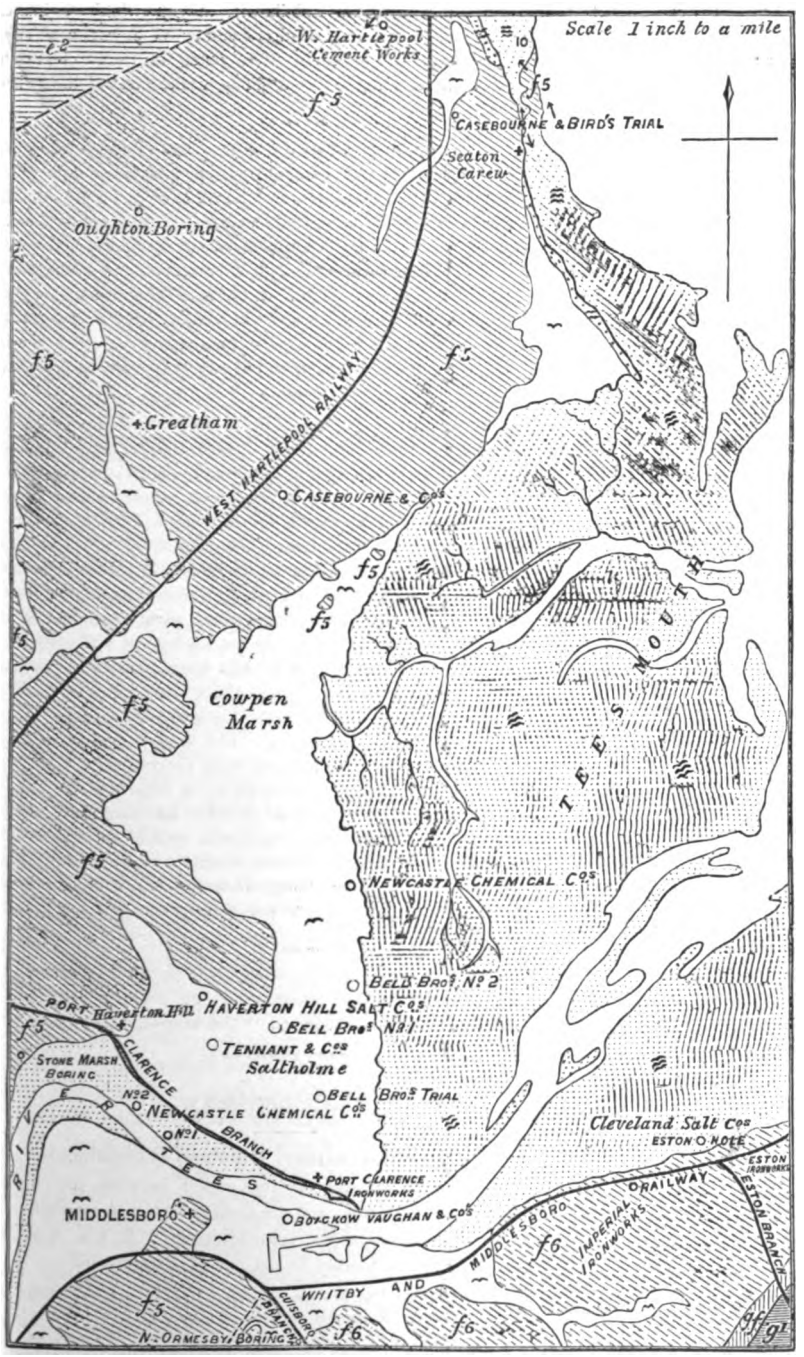
that a bed of these dimensions would contain about 100,000,000 tons of rock-salt per square mile, the immense stores of this mineral which must be contained in the Durham salt field at once become apparent. It is true that a considerable proportion—perhaps a moiety—of the above supplies lie beneath the estuary of the Tees, and are not, therefore, accessible by the only system of working at present in operation in the district. Nor would it be safe to calculate with certainty upon the continuous extension in full force of the thick salt bed beneath the whole of the above area. All experience shows that beds of rock-salt, unlike seams of coal, do not lie in continuous sheets of pretty uniform thickness over very wide areas, but that they have great local developments, and are liable to rapid fluctuations—sudden expansions in one direction and equally sudden disappearances in another. That this is the case in the Durham district is shewn by the failures to find workable salt on the Tees, opposite Middlesborough, and at Stone Marsh, at short distances from places where the rock-salt is so well developed; as also by the considerable fluctuations in thickness which this bed shews when it is pierced by several contiguous wells. Evidently the rock-salt of South Durham consists of one or more great cakes or lenticular masses, at the base of the New Red Sandstone. In this form there is very little reason to doubt that the mineral has a very wide distribution beneath the estuary of the Tees and the bordering districts, beyond the limits of the region already indicated as that under which repeated borings have proved its apparently continuous presence. Going beyond these limits there is, as we have seen, ample proof of the disappearance of the salt deposits on the north, with some indications also of a rapid dying out on the west. How far the thick salt bed extends south and east from the mouth of the Tees it is at the present time impossible to say, but its presence in full force at no less than four points between two and three miles apart on the south bank of this river, certainly favours the view that it has a considerable further extension in that direction. It is, indeed, very probable that rock-salt underlies a large area if not, indeed, the whole of the low-lying country south of the estuary of the Tees, whilst it is quite possible that it extends far beyond that region and beneath the Cleveland Hills of North Yorkshire. In this latter district, however, it will be well to remember that the saliferous measures and rock-salt can only be looked for at very considerable depths, constantly increasing the further south we go. This is mainly owing to the prevailing south-easterly inclination or "dip" of the rocks of this part of England, and in a minor degree to the rise of the ground, and the greater thickness of the higher strata which would on that account first have to be penetrated.



MAP OF THE DURHAM SALT DISTRICT.

e 2, Magnesian Limestone. *f 6*, Red and White Sandstone, with Red Marl, Rock-salt, and Gypsum. *f 6*. Red and Green Marls with Gypsum. *g f*, Black Shales (Rhætic). *g 1*, Dark Shales and Limestones (Lower Lias). ○ Salt-wells and trial-borings.

Alluvium. Blown sand. Tidal flats.

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Museum Notes.

NEW MUSEUM ON ARDWICK GREEN.—A new addition has been made to the natural history museums of Manchester. One of the old family residences on Ardwick Green has been taken by Mr. Henry Hyde, the well-known naturalist, and is being fitted up for the reception of the varied and interesting collections of natural history objects which Mr. Hyde has gathered together from all parts of the world during a scientific career extending over twenty years. Instead of keeping these treasures entirely private, their owner has determined to open his collections to the public, with a laudable desire of popularizing the study of natural history. The botanical department is, so far, the richest and most complete, but the museum includes representative specimens from the animal and mineral kingdoms, illustrating the several sciences of zoology, botany, geology, and mineralogy. At the present time only a part of the building is open, the museum being contained in three rooms, to which others will be added as the great accumulation of objects now stored away in boxes in lumber-rooms can be arranged and displayed. Each specimen is neatly mounted and plainly labelled for the guidance of visitors. The museum is open every day (Sundays excepted), from 9-30 a.m. to 5-30 p.m., a trifling charge being made for admission.

On November 5th the members of the Lower Mosley Street Natural History Society visited the above Museum, where the objects of special interest were pointed out by the curator, Mr. Henry Hyde. A special feature of the museum is the establishment of a separate department for aquaria and living ferns, to which the curator intimated his intention to add a collection of reptilia.

MUSEUM LECTURES.—A feature of growing popularity in connection with museum work is the giving of descriptive lectures on specimens and objects contained in the museum, by curators and others competent to teach. In nearly every district there will be found teachers who will be ready to come forward voluntarily, and assist in the spread of general interest in the facts of science. The idea that a museum is simply a store-house of curiosities has been long ago discarded; the various objects it contains are now seen to be actual scientific realities, a study of which leads to a decided advance in knowledge, pleasantly obtained. Descriptive labels and printed placards are all very well in their way, and the more lavishly these are provided the better; but a few spoken sentences have a far more powerful influence in awakening the interest of the visitor, and giving an impetus to his studies under some properly laid down course of instruction.

THE authorities of the Leicester Free Public Museum were amongst the first to inaugurate a regular series of museum lectures, on systematic lines, and the plan has been successfully adopted in many other towns. The subjects of these discourses (which are usually as informal as possible) being announced beforehand, people have an opportunity of coming prepared to receive some information. In the same way school-classes can be formed to visit the museum for their object-lesson.

A SERIES of these lectures has been arranged in connection with the Museum of the Leeds Philosophical and Literary Society, in Park Row. They are delivered on Saturday afternoons, and the subjects chosen are such as will engage the attention more especially of those who take pleasure in the study of nature and her ways. The first of this season's course was given by Professor Miall, on "The Structure of the Honey Bee," in the lecture theatre. The various stages of the bee's growth were described—all being made exceedingly clear by means of illustrations thrown on a large screen by the aid of the lantern and the lecturer's lucid explanations. There was a numerous attendance, including a considerable muster of schoolboys.—The second lecture was delivered on November 3rd, by Mr Sydney Lupton, on "Crystals."

THE following additions have been made during the past month to the collections of living creatures in the aquarium-room attached to the Liverpool Museum:—A number of salt-water terrapins, from New York; and specimens of the cat-fish, or horned pout (*Amiurus catus*), from New York, presented by Mr. Eugene Blackford, one of the U.S. Fish Commissioners.

THE MANCHESTER GEOGRAPHICAL SOCIETY have had under consideration the question of the foundation of commercial museums, and the Council of the Society hope during next year to bring some practical proposition before their members. For some time past they have made a special feature of visiting public museums and libraries and other similar institutions so as to ascertain the whereabouts of all collections of objects or of books bearing upon geographical research. The riches of public libraries in geographical works is amazing, and the bibliographical lists of these will be issued.

BOOTLE LIBRARY AND MUSEUM FREE LECTURES.—The second season of these lectures was inaugurated on November 13th with a lecture by Professor W. A. Herdman on "The Common Frog," with lime-light illustrations An attractive series of lectures has been arranged for the winter months on each Tuesday evening, commencing at 8 o'clock. Each lecture will be accompanied with lime-light illustrations, and will be given in the lecture hall adjoining the museum. It has also been arranged to give a series of addresses in the museum, which will be illustrated by objects in the collection or by the optical lantern. An address was given by the curator, Mr. John J. Ogle, on November 21st, on the subject of "Swimming Birds."

LIVERPOOL MUSEUM.—The Free Public Museum continues to be open on Monday evenings from seven until ten o'clock, and the large attendances which have gathered on each occasion testify to the popular appreciation of the new movement. Perhaps the most attractive feature is to be found in the demonstration lectures arranged by the curator, Mr. T. J. Moore, occupying half-an-hour or thereabouts, the subject of which is always announced beforehand, and posted in conspicuous positions in the museum building. A demonstration lecture was lately given in the aquarium-room of the museum by Mr. J. Brack Warriner (honorary secretary to the Liverpool Science Students' Association), who took for his subject "Flowers of the Sea." These "flowers" were not the familiar forms of marine algæ known as "seaweeds," but the title was given to those lowly forms of animal life belonging to the actinozoa, and including the sea anemones with all their wealth of colour and variety of aspect. The lecturer first explained the structure of a green hydra, as a type, and then proceeded to describe the sea anemones and other equally interesting living objects in the tanks, his remarks being aided by clearly designed-sketches and diagrams. Many of these creatures were found in great abundance around the coasts of the Isle of Man, happily termed "A garden of sea anemones." The lecture was well delivered in that entertaining manner which, without sacrificing accuracy of description, does much to popularise a love of science amongst the people.

SIMILAR lectures have also been lately given in the same institution by Mr. R. McMillan on "Glass Skeletons;" by Professor Herdman on "Zoophytes," and by Mr. R. Paden on "The Marine Fish."

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between October 16th and November 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board:—

(*a*) Barometer	Highest (October 21st)	30·49	Inches.
,, ,,	Lowest (November 12th)	29·36	,,
,, ,,	Mean	29·942	,,
,, ,,	,, for 21 years October	29·878	,,
,, ,,	,, ,, November	29·874	,,
Temperature	Highest (October 26th)	65·0	Deg. F.
,,	Lowest (October 22nd)	32·6	,,
,,	Mean	48·2	,,
,,	,, for 21 years October	49·3	,,
,,	,, ,, November	43·1	,,
,,	of Evaporation	45·6	,,
,,	,, ,, for 21 years October	46·8	,,
,,	,, ,, ,, November	41·1	,,

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(*b*) Rainfall	Amount	3·331 Inches
„ „	„ Mean for 21 years October	3·723 „
„ „	„ „ „ November	2·748 „
„	Number of Days on which Rain fell	19
„	Greatest fall in 24 Hours (November 12th)	0·620 Inches
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·9
„	„ „ for 21 years October	7·1
„	„ „ „ November	6·6
(*c*) Wind	Velocity Greatest (November 10th)	39 Miles.
„	„ Least (October 16th)	1 „
„	„ Mean Hourly	18·3 „
„	Greatest Pressure on Square Foot (Nov. 10, 8·45 p.m.)	23·5 Pounds.
„	Direction at time of Greatest Pressure	ESE

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
38	202	244	118	110	24	0	8	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

During the latter half of October the weather became milder, and from the 26th to the 28th the mean temperature was unusually high, attaining an average for the three days of 57·9°, being in strong contrast to the weather recorded in the early part of the month, and bringing up the mean of the month to about the average.

During the week ending October 21st the barometrical pressure continued high and steady, with a mean of 30·336 in.; mean temperature 46·09°, with 15·1° of average daily range; duration of bright sunshine only 8 hours 38 minutes; relative humidity 79%; fogs on the 16th, 17th, 18th, and 21st; no rain fell. From the 22nd to the end of the month the pressure was variable, with a mean of 30·052 in.; mean temperature varied from 38·95° on the 23rd to 59·4° on the 27th, with an average of 48·9° and 11° daily range; sunshine only 8 hours; rain fell on nine days to a depth of 1·121 in.; relative humidity 90·8%; fogs on the 23rd and 24th; prevailing wind southerly.

October was remarkable for the great contrast of temperature—33·22° on the 2nd and 59·4° on the 27th. Fog occurred on 10 days, rain on 15, and a smattering of snow on the 1st, humidity being decidedly above the average, the weather calm, and high barometer accounts for dull, foggy days, and also for the small quantity of sunshine recorded. The means or totals for October are:—Barometer 30·036 in.; corrected mean temperature 44·94°; relative humidity 85%; rainfall 2·344 in. (about half the average); sunshine 50 hours, or 16% of the time the sun was above the horizon.

The first fortnight of November was characterised by strong and persistent easterly breezes, caused no doubt by the long-continued anticyclonic conditions over Scandinavia, and the low pressure to the west of the British Isles. The range in pressure and mean temperature has been normal. During the first week the mean pressure was 29·768 in.; mean temperature 44·14°; sunshine, on the 6th only, 5 hours 12 minutes; rainfall (3 days) 0·367 in.; humidity 84%; fog one day. During the week ending the 14th pressure averaged 29·749 in.; temperature 43·01°; sunshine, on the 11th, 49 minutes; rainfall (6 days) 2·431 in; relative humidity 91%.

W. W. MIDGLEY, F.R.Met. S.

Met. Observatory, Bolton, November 17, 1888.

The Weather, October 16 to November 15, 1888.

The band of high pressure which extended over the kingdom on the 15th of October continued with but slight variations till the 23rd, pressure during that time exceeding 30·0 in., and at times being as high as 30·50 in. On the 23rd a steady general fall commenced, and continued on the 24th and 25th, the barometer then ranging from 29·60 in. in the North-West to 30·0 in. in the South-East, and was still giving way slightly in the North on the 26th and 27th, when it remained low till the end of the month, but was tolerably high in the South. On the 1st of November there was a brisk rise in the North and a fall in the South, pressure all over the country varying between 29·60 in. and 29·70 in. The low-pressure area continued on the 2nd to pass to the South, and the barometer was as high as 30·02 in. in the North, but only 29·40 in. in the South. On the 3rd another depression from the West approached, and the barometer gave way generally and continued to do so on the 4th, rising again on the 5th and 6th, but falling on the 7th to rise once more on the 8th, and was very irregular in its movements on the 9th, varying from 29·50 in. in the West to 30·0 in. in the North. On the 10th the barometer was falling briskly, but recovered again on the 11th, falling on the 12th, 13th, and 14th, when it was down to 29·30 in. in the North, but as high as 29·90 in. in the South; and, though the barometer continued to fall in the North, on the 15th it rose to 30·0 in. in the South. The series of depressions which continued from the 4th to the 15th produced strong winds and gales on the coast, especially in the North and West.

	TEMPERATURE.							RAINFALL.				
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	* Means for October. Daily Max.	Daily Min.	Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Oct.* Ins.
Sheffield ...	65°	26th	29°	3rd	47°	—	—	0·69	7	0·20	28th	—
Spurn Head.	63°	27th	35°	5th	47°	—	—	0·77	15	0·22	4th	—
York	66°	27th	26°	2nd	46°	55°	41°	0·81	11	0·17	28th	2·64
Barrow	59°	27th	32°	2nd	48°	—	—	4·29	17	1·10	27th	—
Liverpool ...	65°	27th	33°	22d	48°	54°	45°	1·59	17	0·31	30th	3·62
Holyhead ...	61°	25th	38°	2nd	51°	54°	47°	3·09	18	1·03	27th	4·53
Oxford	67°	27th	29°	3rd	46°	55°	43°	0·72	7	0·24	28th	2·72
London	70°	27th	29°	3rd & 22nd	47°	57°	43°	1·32	9	0·43	29th	2·74

* The means of Temperature and Rainfall for October are for 15 years.

During the week ending October 22nd fair dry weather prevailed in nearly all parts of the kingdom. There was no rain in Liverpool, Barrow, or London. In Oxford and Sheffield there was no rain from October 4th to the 24th—an unusually long dry period for the time of year. There were thick fogs in many places and night frosts in the inland towns, the temperature generally being low, especially in the South of England. The following week, ending October 29th, showed a decided change from the dry cold weather of the previous week. The high-pressure system, which had prevailed since the beginning of the month, gradually broke up, and the weather became very mild and humid, the wind was high, and a great deal of rain fell, especially in the North and West. On the 27th temperature was as high as 70° in London and 69° in Loughborough, and the minimum readings on the 28th were very little below 60° in any part of the kingdom. There was rain on six days at Liverpool, Barrow, and Holyhead; on four days at London and Oxford, three at Sheffield, and two at Spurn and York. More than an inch of rain fell at Barrow and Holyhead on the 27th. The next week, ending November 5th, was still more unsettled, with heavy rain in nearly all parts of the kingdom, and occasional gales on all but the Southern coasts. There was thunder and lightning in Scotland on October 30th, and lightning was seen in the South of England on November 1st and 2nd. Temperature fell during the week, and was very little above its average level. Rain fell on six days at Liverpool, Spurn, York, and Sheffield, on five days at Oxford, and on four days at London and Barrow. From November 6th to the 15th (ten days) the weather was dull and cold everywhere, with heavy rain and strong winds. There was snow in Devonshire on November 7th, and in North Wales on the 8th. On the 12th, 1·14 in. of rain fell at

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Holyhead, and the rainfall exceeded an inch at Sheffield and several other places. There was rain at Holyhead and Oxford on eight days, at Barrow and Liverpool on seven days, at Sheffield and London on six days, and at Spurn and York on five days.

ASTRONOMICAL OCCURRENCES IN DECEMBER.

Spots are becoming more frequent on the sun's surface, but the weather in November did not permit very extensive observations to be made of them. On the 6th of November there was a group of spots, consisting of one large one and three or four small ones, with well-marked faculæ near the sun's eastern limb, and on the 14th this group had passed obliquely to the western side of the sun, and the smaller spots had coalesced, and the whole was surrounded by one penumbra, while another group of spots very similar to the above had traversed about one-quarter of the sun's diameter from its eastern limb. The sun's face is likely to repay observation in December.

The moon is new at 10-6 a m. on the 3rd, attains her first quarter at 6-46 a.m. on the 10th, is full at 10-41 a.m. on the 18th, and enters her last qnarter at 6 a.m. on the 26th. She is in perigee at 4 a.m. on the 3rd, in apogee at 4 a.m. on the 16th, and in perigee again at 3 p.m. on the 31st. The earth will make its nearest approach to the sun at 4 p.m. on the 31st.

Venus is an evening star, though badly placed for observation; but it may be picked up near the southern horizon, after sunset, towards the end of the month. At the beginning of the month Saturn, which is situated in the constellation of Leo, will rise at a quarter past 9, and at 7-20 p.m. at the end of the month. Neptune is visible all night, and is situated in Taurus.

Barnard's comet made its nearest approach to the earth about the 21st of November, and its brightness is now decreasing. The perihelion passage will not take place till January 31, 1889, and the comet will be visible in telescopes for some time yet.

E. HOWARTH, F.R.A.S.

Weston Park Museum, Sheffield, November 20th, 1888.

Reviews.

Recent Archæological Explorations in County Sligo. By S. F. Milligan

IN this *brochure*—which formed the subject of a paper read to the Belfast Naturalists' Field Club—the author brings into one focus a large mass of interesting facts bearing upon the ancient stone monuments of a district rich in archæological associations. He has had the good fortune to explore the ruins of a great megalithic structure at Magheraghanrush, which may be described as the Stonehenge of Ireland. This rude stone monument has puzzled all the antiquaries, none of whom have been able to solve the problems connected with it. Mr. Milligan, however, had recourse to the pick and spade, and discovered beneath the soil the remains of small "cists" containing in every instance human bones, together with those of other animals, such as ox, goat, hare, &c. It is worthy of remark that at the entrance to the structure are three trilithons, or open doorways, a feature seen at no other similar structure in Great Britain excepting at Stonehenge. There is little doubt that the structure now examined was erected as a sepulchral monument.

Quarterly Journal of the Geological Society.
[Vol. xliv. Part 4. November, 1888.]

THIS part completes the forty-fourth volume of the Geological Society's publication, and is quite as bulky and as full of valuable matter as usual. The most important paper printed is an elaborate memoir on the Durham salt district, by Mr. E. Wilson, illustrated by numerous sections of deep borings, which convey much information. Most of the papers, however, are of local interest. Mr. J. H. Collins describes the Sudbury copper deposits, and Mr. J. R. Kilroe has an interesting contribution on the direction of ice flow in the north of Ireland. The movements of rocks are treated of by Mr. C. Davison (scree material), and by Mr. W. Barlow (horizontal movements by gravitation). Mr. F. Rutley has a good petrological paper on the perlitic felsites of the Herefordshire Beacon.

Societies.

CHESTER SOCIETY OF NATURAL SCIENCE.—The recent meetings of this active Society have been particularly attractive. On October 25th Dr. T. Eyton Jones, of Wrexham, gave a lecture on "Egypt," a subject of never-failing interest. This was followed by meetings of the various sections of the Society in November. In the newly-constituted photographic section Dr. Stolterfoth gave some useful hints on micro-photography, a branch of microscopy which is now very popular. In the section devoted to applied science, Mr. F. C. Phillips, A.M.I.C.E., read a paper on "Electric Lighting," which served to call attention to the great extension now being effected in the public use of electricity as an illuminant. The botanical section had before them a capital paper by the chairman (Mr. J. D. Siddall), on "Notes on the Protista, the Borderland between Plants and Animals."

CROSBY LITERARY AND SCIENTIFIC SOCIETY.—A lecture was delivered on October 31st before this Society by Mr. Osmund W. Jeffs (of the Liverpool Geological Society) on "Lakes and their Origin." The various methods of formation of lake-basins, by land subsidence, extension of river-valleys, blocking up of valleys by landslips, lava-flows or moraine heaps, and by glacial erosion were described and illustrated by a fine series of diagrams and photographic views of lake scenery.

NATURAL HISTORY SOCIETY OF GLASGOW.—The 37th annual general meeting of this Society was held on Tuesday, 30th October, Mr. Thomas King, vice-president, in the chair. The secretary (Mr. D. A. Boyd) read the report of the Council on the progress of the Society during the previous year, which stated that the names of 5 honorary, 10 corresponding, and 111 ordinary members had been added to the roll, the total membership being 342. The various departments of the Society's work continued to be maintained in a satisfactory state of efficiency. Reports by the treasurer and librarian were also submitted and approved. Mr. A. Somerville, B.Sc., F.L.S., was elected a vice-president, and other office-bearers were appointed. Mr. James J. F. X. King exhibited a partial albino blackbird, shot in the neighbourhood of Kilbarchan, Renfrewshire. The Rev. John Muir exhibited a series of ophidia and scorpionidæ from the South of India, and described the various sub-orders which the specimens illustrated. Mr. R. Broom, B.Sc., made some remarks on the snakes, and referred particularly to the rarer and more interesting forms. Among these were specimens of *Cynophis malabaricus*, *Passerita purpurescens*, and *Trimeresurus anamallensis*. A very fine series of the shells of *Isocardia cor*, one of the rarer marine mollusca, was submitted for exhibition. Among the specimens was an adult, dredged in July, 1887, between Lesser Cumbrae and Brodick, and especially interesting as the first living example recorded from the Clyde. This was kindly lent for exhibition by His Grace the Duke of Argyll, K.G., K.T., D.C.L., F.R.S. Numerous other specimens, from various marine districts, were shown by Mr. David Robertson, F.L.S., F.G.S., president; Dr. John Murray, F.R.S.E., F.L.S., honorary member; Mr. W. Anderson Smith, corresponding member; Mr. James Paton, F.L.S.; Mr. D. Corse Glen, C.E., F.G.S., and Mr. A. Somerville, B.Sc., F.L.S. A paper was read by Mr. Somerville, in which reference was made to the various specimens, and a general account given of the species and its area of distribution. Mr. John Renwick exhibited fasciated main-stems of the Austrian pine (*Pinus austriaca*), grown on the estate of Traquair, Peebleshire.

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ISLE OF MAN NATURAL HISTORY AND ANTIQUARIAN SOCIETY.—The October meeting of this Society was held in the School of Art, Douglas. Deemster Gill read a report as the Society's delegate to the British Association at Bath. Mr. P. M. C. Kermode, the secretary, read a list of Manx land and fresh-water shells, taken by Mr. Lionel E. Adams, which contained several species new to the Isle of Man, amongst which are the following :—*Limax arborum ; Zonites aliarius (? sp.) ; Planorbis nautilus, v. cristata ;* and *Pisidium roseum (? pusillum)*. Mr. Kermode appended a list of addenda giving several species not quoted in Mr. Adams' list. We observe that the Society contemplates the publication of a journal, with the view of exciting further interest amongst the members in the Society's operations.

THE LEEDS NATURALISTS' CLUB AND SCIENTIFIC ASSOCIATION.—At a meeting of the above Club lately held at the Yorkshire College, the President (Professor L. C. Miall, F.L.S., F.G.S.) in the chair, the evening was devoted to "Practical Microscopy," when, under the direction of the President, the process of preparing and mounting animal sections in celluloidine was fully elucidated, this forming a supplement to an evening on the same subject some three or four weeks ago. On this occasion the object under treatment was the "Honey Bee," which presents several difficulties over animals of softer bodies, as the chitinous integument and the two large air sacs on either side of the body offer a firm resistance against the celluloidine penetrating the internal tissues; but by disconnecting the head, thorax, and abdomen, by careful manipulation, the fluid celluloidine can be got to permeate and render the object sufficiently solidified as to allow being cut into sections by the microtome. This was demonstrated with the most encouraging result before the members, transverse sections being made through the head, and sections through the abdomen were mounted and examined. An interesting description of some of the important features of the slides was given, and the President gave a comprehensive lecture on the entire process, commencing with the mode of killing the objects, and passing on to subsequent methods of treatment and the re-agents necessary.

LIVERPOOL GEOLOGICAL SOCIETY.—At the monthly meeting of this Society, held on November 12th, Dr. C. Ricketts, F.G.S., described some interesting specimens of liassic fish remains and other fossils from fissures in the carboniferous limestone at Holwell, near Frome, obtained by him during the recent meeting of the British Association at Bath. Mr. O. W. Jeffs exhibited an old atlas, kindly lent by Mr. E. K. Hayward, dated probably about 1750, and engraved by Tobias Conrod Lotter, of Augsburg. The features of the maps consisted in the principal meridian being taken from Teneriffe, and the delineation of the great lakes of Africa (supposed to have been only recently discovered) which are placed in their approximate positions as feeders of the Nile. The paper of the evening was then read by Sir James Picton, F.S.A., entitled "Notes on the Local Historical Changes in the Surface of the Land in and about Liverpool." Sir James first called attention to a series of maps illustrating the topography of the neighbourhood. These were of various dates, the oldest representing Liverpool in 1650, and showed the gradual extension of the docks and buildings and the development of the inhabited portion of the region depicted. He then proceeded to explain how the cultivation of the land, draining of the marshes, improvement of watercourses, and construction of canals and railroads have imparted to the country an entirely different aspect to its natural character. Geology showed the effects of natural forces, ever at work, in altering the surface-contour of the land, and these changes were often aided by the direct operations of man. Since the foundation of Liverpool there had been many changes in its superficial contour well worthy of notice. At the close of the glacial period the landscape on the eastern side of the Mersey presented a picturesque aspect, resembling the rocky slopes of Bidston Hill on the opposite side of the river, and the high lands at Everton, Low-hill, and Edge-hill were broken up into crags and precipices with deposits in the hollows. This declivity was interrupted by two ancient sea margins, referred to by Mr. Robert Chambers, one of which was stated to occur near the summit of William Brown-street, just under the Walker Art Gallery. The upper sea margin constituted the flat ground at the foot of Low-hill, on the summit of which was a pre-historic tumulus. The author gave a mass of topographical detail of an interesting character, in the course of which he referred to the old Moss Lake and other physical features which have long become obliterated. He claimed that the valley of the Dee had for many ages been undergoing a process of shallowing and silting, and that the channel of the Mersey had been gradually deepening. Thus, whilst one valley was sinking, the other had been gradually rising, such diverse action going forward in two estuaries so near to each other being a very remarkable phenomenon. The globe which we inhabit was not a more inert mass; forces of elevation or depression were continually in progress. The greater or less depth of water in a river channel might change the entire course of commerce, and affect the welfare of millions. It was necessary, therefore, to watch these processes of nature, and aid by science and skill whatever makes for the benefit of our race and age.

LIVERPOOL ENGINEERING SOCIETY.—A paper was read on the 14th November by Mr. T. Mellard Reade, F.G.S., F.R.I.B.A., on "The Advantages to the Civil Engineer of the Study of Geology." Mr. Reade quoted several instances in which a knowledge of geology would have been of the greatest benefit to engineers entrusted with the construction of important works. Speaking of reservoirs, he said that owing to a faulty idea of the geological surroundings of sites for such purposes disastrous mistakes might easily be made, and he mentioned a case in which a local board incurred double expense owing to a reservoir being placed in an unsuitable position, the water permeating its bed and sides, and this, he stated, might have been avoided had the engineer been in possession of better information on the particular branch of science to which he referred. Acquainted thoroughly with geology, the engineer would be able to overcome many difficulties in connection with tunnels, railway cuttings and embankments, canals, &c.; and, with reference to the first-named, he spoke of the subsidence which took place during the progress of the Mersey Tunnel works. Some years ago he indicated that the excavations would have to be carried on at a lower point than was primarily intended, in consequence of a channel of drift which lay below the level of the bed. This was at first scouted by the engineers, but eventually his words were verified, and advice acted upon, the works being sunk to a lower point, thus affording an instance of the utility of geological knowledge applied to great engineering works.

LIVERPOOL SCIENCE STUDENTS' ASSOCIATION.—The opening meeting of the winter session of this Association was held on October 19th at the Royal Institution. Miss E. M. Wood gave a *résumé* of the botanical work of the summer session, which had been fruitful in the acquisition of several floral rarities by those members who attended the various field meetings, after which the President (Mr. Osmund W. Jeffs) delivered the annual address, alluding in the first place to the work already accomplished by the Association, and indicating several directions in which its future vigour and usefulness may be developed. The study of biology was referred to as possessing a wide range amongst the natural philosophies. It was the *raison d'être* of the naturalist, and interested alike the student of to-day and of the long past. There was scarcely a spot which did not yield some vestige of the presence, at some time or other, of that active principle called "life," and a study of this science opened our minds to some of the highest and most reverential ideas of which the human intellect was capable. Anthropology, or the natural history of

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the human species, also deserved careful study, for the furtherance of which special facilities existed in Liverpool, where the different racial types from all quarters of the globe met together; and closely connected with this was archæology—the science of ancient things—a kind of *via media* between anthropology and what was generally classed under the term of "history." Both in connection with this subject and with natural science much assistance could be obtained by students from the admirable collections displayed in the Free Public Museum. There was a growing feeling that a museum should be something more than a storehouse of curiosities; it should be a more direct means of conveying knowledge. Viewed in this light, the educational value of a museum became much enhanced, a fact which doubtless had its share in inducing the local authorities to open the Public Museum on Monday evenings. The remainder of the address dealt with the geology of the Cheshire hills. The second meeting of the session was held on November 16th. A paper on "Instinct in Plants" was read by Mr. R. H. Day, and another on "The Philosophy of Cross-Fertilisation" by Mr. J. W. Baylis. The wonderful variety of flowers in form, colour, and odour was graphically pourtrayed, evidencing that they were factors in the production of cross-fertilisation, which consisted in the fertilisation of the ovaries or flowers by pollen from other flowers of the same species, effected through the agency of the wind or insects. The conveyance of pollen is essential in the great majority of plants, the sexes in some cases being borne on separate flowers, and even when the male and female organs are united in an individual, self-fertilisation is made difficult or impossible by various causes, such as the relative positions of the organs and the different periods at which they arrive at maturity. The curious contrivances and modifications that flowers, especially orchids, possessed for the furtherance of cross-fertilisation, and the inter-dependence of flowers and insects in the struggle for existence, were alluded to at considerable length. In closing, the essayist referred to the researches in this direction of the late Charles Darwin, and said the theory of natural selection was alone adequate to explain the phenomena. An interesting discussion followed, many members taking part, after which Mr. W. Read exhibited in the lantern some slides illustrative of the coal measures of the Wigan coal field.

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Western Microscopical Club, London.—At a meeting of this Club held on Monday, Nov. 5, 1888, Mr. F. P. Pascoe, F.L.S., read a paper on *Ants*, an abstract of which will be found on another page. The subject was well illustrated with specimens of the various ants, their allies and their messmates, both British and foreign. In the interesting discussion that ensued, Dr. B. T. Lowne threw much light upon the development of the various organs of the ants, comparing these with those of allied genera. Drs. Snow, Meiklejohn, and Karop, with Messrs. Tebbs and Stokes, contributed their experiences of these interesting beings. The next meeting of the Club will be taken by Mr. B. T. Lowne in December, who will exhibit and explain his researches on "The Anatomy of the Blow-fly."

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Manchester Field Naturalists' Society.—The winter session of the Society was opened on October 31st, when a paper was read by Mr. William Carr upon "Honey Bees." The author gave in this paper the results of many years' study and practical observation, and exhibited many curious volumes and drawings relating to bees and bee-culture.

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Manchester Association of Science and Art Teachers.—At the monthly meeting of this Society, held November 3rd, Dr. G. H. Bailey, of Owen's College, gave a short address on the "Teaching of Chemistry." He remarked that in regard to the Science and Art Department Examinations the gulf between the elementary and advanced stages was too great, and he considered that some alteration should be made with a view of bridging this gulf. Teaching as it should be done does not pay, whether it be an elementary school, a science school, a college, or university. The education of the present day is not teaching but cramming to pass examinations, and the result is that we have developed among us two classes of men, the professional examiner and the "coach." The former endeavours to catch the candidate by his questions, the latter studies the examiner's peculiarities and crams his pupils with tips for examination purposes which are forgotten when it is all over. Dr. Bailey said the teaching of practical chemistry under the auspices of the Science and Art Department was done wrongly, and that the method of teaching which was developed out of the requirements of the examination did not make the student a practical chemist. Mr. William Leach afterwards gave a demonstration with his Lantern Microscope.

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Manchester Conchological Society.—At the monthly meeting of this Society, held on October 31st, Mr. Edward Collier read a paper upon the "Shells of the Ingleton District," describing the results of his collecting in and about Ingleton during a visit of some weeks in August last. A careful search of Helks Wood was made, which proved extremeley rich in molluscan life, especially the rarer species of shells. The following species were noted:—*Lim. peregra*, plentiful in an old horse-trough on the Clapham-road, and in the stream which runs through Clapham village. A few *Lim. truncatula* occurred on the wet rocks near the Pecca Falls, Ingleton, and the freshwater limpet, *Ancylus fluviatilis*, was common on stones in the stream running through Clapham village. It also occurs in the rivers Doe and Greta, at Ingleton, but was not taken owing to the flooded state of these streams. The beautiful amber snail, *Succinea elegans*, was taken in a wet ditch on the Bentham Road, and *Vitrina pellucida* was fairly common in Helks Wood and at Clapham, but only small specimens. *Zonites cellarius* was common in Helks Wood and around Ingleton, also at Clapham, and two beautiful specimens of *Var. albinos* were taken. *Zon. alliarius*, the garlic snail, was common, and the *Var. viridula* occurred rarely. *Zon. glaber* and *Zon. nitidulus* were uncommon, but the scarce and lovely *Zon. purus* was found abundantly in Helks Wood, as were also *Zon. crystallinus* and *Zon. fulvus*, the latter rare species being very fine. The prickly snail, *Helix aculeata*, was also plentiful in Helks Wood under stones and amongst moss, and a good supply of this rare species was secured. *Helix aspersa* was abundant and remarkably fine on old walls behind clumps of nettles anywhere about Ingleton, and a few examples of the *Vars. conoidea* and *undulata* were found. *Helix nemoralis* was notably scarce, but *Helix hortensis* was commoner, mostly of the five-banded form, with a few of the yellow, bandless *Var. lutea*. *Helix arbustorum* was common all about Ingleton, and very varied in form and marking; the small *Var. alpestris* was not uncommon. A few of the remarkably high-spired *Var. trochidalis* were taken, and also a fine specimen of *Monst. subscalariform*, and a few *Vars. flavescens* and *marmorata*. *Helix rufescens* and its *Var. rubens* were pretty common, and also *Helix hispida*. One of the most interesting finds was *Helix ericetorum Var. minor*, on grassy slopes facing west and south-west on Storr's Common. It was noted as remarkable that the limestone-loving *Helix lapicida* was not taken about Ingleton. *Helix rotundata* and *Helix rupestris* were common, the latter appearing in thousands on the lime-stone walls after rain, and some very interesting examples of it were found, showing it to be an *ovo-viviparous* species, some of them having a number of young ones, with 1½ or 2 whorls, imbedded in the body of the animal protruding from the shell. A few *Helix pygmæa* and *Helix pulchella Var. costata* were found in Helks Wood. *Pupa umbilicata*, and a short dumpy form of it known as *Var. curta*, was common. *Bulimus obscurus* occurred sparingly in Helks Wood on trunks of trees, and a few *Pupa secale* were picked up, but only as dead shells. *Vertigo edentula* was taken in Helks Wood sparingly, and Mr. Standen found *Vertigo pygmæa* rather common in

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some moss he took home with him from the same place. The rare little *Vertigo pusilla* was found plentifully in Helks Wood alive under the stones and amongst moss brought home. Attention was drawn to the plan of taking home moss, and drying and looking through it for the smaller species, as being very productive. *Balea perversa* was locally plentiful on moss-covered walls shaded by trees, and best found after heavy rain. *Clausilia rugosa* was extremely abundant on every wall after rain, and some unusually fine specimens of its *Var. dubia* were taken near Beesley Grange on an old moss-covered wall, and also at Twistleton Scar End. Where this variety was found the ordinary type did not occur, which Mr. Collier instanced as pointing to its being a different species from *Clausilia rugosa*. *Clausilia laminata* was very plentiful on tree trunks, and on stems of nut bushes in Helks Wood. *Carychium minimum*, *Coch. tridens*, and a few of its *Var. crystallina*. together with *Coch. lubrica*, and *Vars. ovata* and *lubricoides*, were taken abundantly in Helks Wood. One specimen of the extremely rare *Acme lineata* was found by Mr. Standen in moss from Helks Wood, and was looked upon as a most interesting find. Altogether thirty-seven species, exclusive of named varieties, were recorded, which gives an addition of fifteen species to previous records for this district. Specimens of all the species and varieties described were exhibited at the meeting, and were much admired.

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MANCHESTER MICROSCOPICAL SOCIETY.—MOUNTING SECTION.—At the usual meeting of the Mounting Section of this Society, on Thursday, the 15th inst., Mr. E. Ward, F.R.M.S., gave a practical demonstration on Fluid Mounting, Mr. Ward stating that as a result of ten years' experience he considered carbolised water to be the best preservative medium for fluid mounts, using an ordinary brown cement cell. In those cases, however, where a solvent of the brown cement had for some reason or other to be used instead of water, Mr. Ward got over the difficulty by coating the brown cement ring with a layer of balsam and benzole.—Mr. J. L. W. Miles gave a demonstration on the Mechanism of the Microscope, explaining very fully and very lucidly the arrangement and application of the different portions of the microscope. This demonstration was very highly appreciated, especially by those who were either beginners in microscopy or had not had sufficient opportunity of making themselves acquainted with the instrument. In the practical demonstration coarse epithelial cells, cartilage and fibrous tissue were considered. In the first, nucleated and non-nucleated cells were taken, the former from the inside of the cheek, the latter from the palm of the hand. These were stained with fuchsin. The case skin of the newt, hardened and fixed in alcohol, formed another specimen of epithelial cell. This was treated with logwood and mounted in Farrant's medium. Hyaline, white and yellow cartilage were then investigated. The first, from the costal cartilage, after being treated with picric acid, was stained with carmine, the superfluous stain washed away, and then treated with glacial acetic acid, and also mounted in Farrant, showing the periphery fibrous and denser in appearance (the perichondrium), then next inside "corpuscles" small, arranged in several layers, some with single, others double granular large nucleus. In the white fibro-cartilage treated similarly the matrix was noticed with fine unbranched fibres, the fibrous portion passing into the subjacent bone. For yellow fibro-cartilage the epiglottis of the cow was taken, hardened and stained with picro-carmine. Here was seen, first, the mucous membrane along the edges, beneath this the perichondrium stained red, cartilage matrix stained yellow, nuclei of corpuscles stained red, and running through the matrix fine branched lines (fibrous tissue), merging into the perichondrium. For dense white fibrous tissue the tendon Achilles was used, hardened and stained with logwood. Here was seen, first, the sheath of connective tissue, then the closely-arranged fibres forming tendon. These latter, viewed with a high power, were seen to be longitudinally arranged, some wavy, but never branched, spindle-shaped fusiform cells with nuclei (connective tissue corpuscles).

LEEDS GEOLOGICAL ASSOCIATION.—The annual meeting was held on October 25th. The president, Mr J. E. Bedford, F.G S., gave an address on "Natural Gas, and the Oil Fields of Russia and the United States." After giving an interesting account of the occurrence of petroleum in Pennsylvania and the district of Baku in Southern Russia, and describing the methods of obtaining the oil, the president explained that petroleum oil and gas are found in strata of many geological ages, mentioning deposits in the Lower Silurian, Devonian, Triassic, and Cretaceous rocks. Referring to the theories which have been adduced to account for the formation of petroleum in the rocks, he stated that some great chemists think it has originated by the union of inorganic elements, that the carbon existing in the strata combined in some way with hydrogen and oxygen. The more generally received opinion is that the oil is the result of the decomposition of animal and vegetable remains, which lived at the time when the rocks were laid down. The evidence seems to point to animal remains as the most likely to yield hydro-carbons. If the oil had been derived from plant life, one would expect to find the fossil plant remains in fair quantity, but this is not so. Coal strata would be expected to furnish oil; but little, if any, is ever found in them. Animal remains are always found in strata yielding oil. The Trenton limestone contains orthoceratites in great quantities, and the cavities often contain several ounces of oil. Hoefer says that all slates which give hydro-carbon oils on distillation are rich in animal remains, while they show few of vegetable origin; and that the rocks which contain large quantities of vegetable remains are not bituminous as a rule, but become so when animal remains are also present. The fact of salt water being so often present with petroleum also points to a marine fauna. Supposing that these fossil remains have been subjected to heat and pressure for a great length of time, as they no doubt have, then great chemical changes would occur; decomposition would begin with the nitrogenous portions of the animal (the gelatine, albumen, &c.). The fats, not being so easily changed, would remain to a later period and be absorbed by the rocks. These fats are different in chemical constitution from the paraffin series of oils, and further decomposition would be necessary to produce paraffin. The latter are not so complex in the construction of the molecules as organic fats are, being less organised, one might say, and approaching more nearly to carbon compounds of mineral origin. This points to the assumption that the process of dissociation, and the reforming of other compounds, had proceeded until a substance had been formed which refused further chemical changes, and this has resulted in the whole series of paraffins known to chemists. Professor Mendeléef is of opinion that petroleum is produced by water, which penetrates the earth's crust, and comes in contact with glowing carbides of metals, especially those of iron. The water is decomposed into its constituent gases, the oxygen uniting with the iron, while the hydrogen takes up the carbon and ascends to a higher region, where part of it is condensed into mineral oil, and part remains as natural gas, to escape wherever and whenever it can find an outlet. If this assumption be correct, and a sufficient store of metallic carbides is contained in the earth's interior, petroleum may continue to be formed almost indefinitely, and yield a supply of fuel long after coal has become exhausted. The professor supports his views by producing artificial petroleum in a manner similar to that by which the natural product is made. As to the life of a gas well, or, in other words, the length of time when gas will issue from it, only theories can be indulged in. We know that the flow of gas from these wells does diminish, still yet not so far as to discourage investors. The natural gas territory is of such vast extent that, should the life of the first wells drilled be comparatively short, others may be drilled in other parts of the district, and (approximately) the same amount of gas may be obtained. This has been demonstrated to be a fact, so far as present experience teaches. However, there seems to be a general opinion that, in process of time, all the gas wells will be exhausted. It is stated

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that there is not to-day a single gas well in Pennsylvania which is giving out 50 per cent. of the volume of gas which it originally did, and in many instances gas wells of enormous pressure when first opened have been abandoned. Mr. Bedford gave the following analysis of natural gas from Findlay, Ohio :—Marsh gas, 92·61 ; olefient gas, 0·30 ; hydrogen, 2·18 ; nitrogen, 3·61 ; oxygen, 0·34 ; carbonic oxide, 0·50 ; carbonic acid, 0·26 ; sulphuretted hydrogen, 0·20. This must not, however, be taken as the standard composition of this gas ; it is very variable. Samples taken from one well at different dates have been found to vary in nitrogen from 23 per cent. to 0 per cent. ; in carbonic acid from 2 per cent. to 0 per cent. ; in oxygen from 4·0 per cent. to 0·4 per cent., and so on. This fact of variable composition has given rise to many interesting questions and theories. S. A. A.

Letters to the Editor.

The Natural History of the Birkdale (Southport) District.

Sir,—I take it that you will oblige the readers of *Research* and aid the study of natural history if you encourage correspondence on the plant and animal life found in our district. I was, therefore, pleased to find you had inserted letters on the finding of the nightjar—one particularly interesting, signed "R. S." May I, however, be permitted to call in question the finding of stockdoves, as stated on p. 13 of the first issue. I speak with some hesitation, but I do not think the stockdove is found on the sand hills. Here is a possible explanation :—Pigeon shooting matches are common on the sand hills (no credit to the district), and it is the opinion of men who know the hills well that the escaped pigeons live and breed there. Is your correspondent sure that he saw nests of the stockdove and not of the domesticated pigeon?

Birkdale, Southport. H. M.

The Fundamental Colours—Blue *v.* Violet.

Sir,—The following facts, if they have not escaped observation, have been strangely overlooked by writers on the subject of colour. I have observed that the violet of the spectrum appears decidedly bluer when examined by an eye rendered slightly red-blind by continued exposure to red light. Gazing at the sky through ruby stained glass for about a minute suffices to secure this result, but I find it advantageous to leave one eye in its normal condition for the sake of comparison. In a similar manner, with the aid of blue glass, the eye can be rendered temporarily less sensitive to blue, in which case the spectral violet for a short time assumes a ruddier tint. A common prism shows these effects fully better than a spectroscope, enabling comparisons to be made more rapidly and conveniently. The results are at once accounted for if we suppose violet to be compounded of two sensations, blue and red ; but they seem inexplicable if violet is a fundamental sensation, as maintained by Helmholtz and most physicists who accept Young's theory of colour.

From similar experiments on the yellow and orange of the spectrum, using in this case a spectroscope, we may infer that those colours are compounded of the green and red sensations, since their tint is changed very much in the direction of green when the eye has been exposed to red light, and towards red when the eye has been exposed to green light. Even more striking changes can be effected in the green-blues and blue-greens of the spectrum by exposing the eye to green or blue light, the Fraunhofer line F conveniently indicating the remarkable displacement of colour which occurs. But I have not succeeded in causing the blue midway between lines F and G to assume a violet or green tint by fatiguing the eye with green or violet light respectively. This result seems inexplicable unless we suppose blue to be a fundamental sensation. No marked changes, disregarding variations in intensity, can be effected in the green and red of the spectrum. Thus, by a sort of analytical process, we arrive at the conclusion that red, green, and blue are the fundamental colours. These colours were selected as fundamental by Clerk Maxwell, who was led to adopt them by synthetic experiments, *i.e.*, by mixing coloured lights.

In addition to the above facts, it should be noted that exposure of the eye to red light containing neither green nor yellow lessens the sensitiveness of the eye to green sufficiently to cause blue-greens to appear slightly more blue. Blue light free from green has also the same power, its prolonged action upon the eye causing yellow to assume an orange tint. An alkaline solution of litmus will furnish a red light, and ammonio-sulphate of copper a blue, both free from green, if the solutions are sufficiently strong.

Most of the above experiments, especially those relating to violet, have been confirmed by friends who did not know beforehand what results to expect. F. W. Reynolds.

32, Pelham Grove, Liverpool.

Jottings.

Wirral Footpaths and Open Spaces Preservation Society. —A society has been formed with the above title, its objects, as stated in the rules, being as follows :— "The preservation, maintenance, and defence of the rights of the public to the use and enjoyment of public highways, footpaths, bridlepaths, bye-ways, and other rights of way, vacant spaces, commons, waste lands and roadside slips in the Hundred of Wirral, in Cheshire, free from obstruction, nuisance, and annoyance. The prevention of the abuse of such rights, especially trespass and damage to crops and property and disturbance of game by trespassers, the support, by influence, petition, or otherwise, of bills in Parliament promoting the aforesaid objects, or any of them, or others of a like or kindred nature, and all objects conducive to the foregoing, including the combination or co-operation with other societies or persons in the promotion or furtherance of the aforesaid objects or any of them." Reference has already been made in our columns to the desirability of establishing societies in different parts of the country for the purpose of securing protection to public rights of way on footpaths, commons, &c., and we are glad that a movement in this direction has been started in Cheshire. The secretary of the Wirral Society is Mr. T. H. Thorneley, 5, Fenwick-street, Liverpool. At a recent meeting a very practical preliminary step was taken. It was resolved to prepare a map of the district, and register all footpaths and land over which public rights exist. An organisation of this kind should be established in every county, and we shall have pleasure in giving a record of the places found to be legally within the public right of access, for the information of naturalists and science workers generally. Secretaries are requested to keep us informed on the point in question.

The *Psychologische Bladen* is the title of a new illustrated periodical published in Holland, devoted to the science of Psychology. Though there are in England some magazines which profess to investigate the higher phenomena of mind, they mostly exist as organs of a peculiar class of the community which has no claim whatever to research on a scientific basis. It must be confessed that there is a wide field for work in this department of science, hitherto but little explored by earnest, truth seeking students, though the charlatan has long found amongst its devotees a happy hunting ground for his dubious exercises. The new journal has seemingly but one drawback. It is printed in the Dutch tongue, which does not seem as yet to have made much headway as an universal language. Its object appears to be the scientific investigation of mental and physical phenomena. It is edited by M. Max Bruck and M. C. W. K. Kleinpenning.

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Research:

A MONTHLY ILLUSTRATED JOURNAL OF SCIENCE.

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NOTICES.

Last month "Research" was increased by the addition of four pages, and, as will be seen in the present number, this has allowed of the insertion of a greater number of Reports of Societies' Meetings, &c.

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & CO. Price 3d., or by post, 4d. Annual Subscription 3s., or by post, 4s.

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Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Museums and the Masses.

SIGNS are not wanting at the present time that strong efforts are being made to render museums more useful as educational aids than they have hitherto been. One of the most attractive of the Sections at the Art Congress recently held in Liverpool was that devoted to museums, and from many directions come reports of recently-instituted museum lectures, activity in the arrangement of the collections, and other work which must be peculiarly gratifying to those who wish our museums to be really serviceable institutions. Let us hope that this activity will not be allowed to flag.

It is necessary, however, to carefully bear in mind that these collections are not for the use and enjoyment only of the learned few, but that they can be made of great educational value and of much assistance in the intellectual uplifting of the masses.

And what is wanted is to create a greater interest in them amongst the public generally, and to show how they can be used to advantage. Probably, one of the best ways to do this permanently is by means of school collections and such circulating cabinets as were described in our September number, by the Rev. H. H. Higgins. Foster a taste for the study of these objects amongst the children in our schools, and our museums will, as time goes on, not present the deserted appearance too many of them now show, but will be visited by large numbers who can intelligently appreciate the objects exhibited. The powers of observation, habits of careful inquiry, and the thinking faculties of many children can be far more quickly and usefully trained by such object lessons than by much of the so-called education now given in our schools. The writer not long since spent a very pleasant evening in the Government Museum of Science and Art, Edinburgh, in watching two or three groups of shoeless, ragged children, who evidently had had some such lessons as those above referred to. These children—who most likely would have been unceremoniously cuffed out by the policeman from many museums—were undoubtedly intelligently discussing the contents of different cases, and learning much that may be serviceable in after life, and help to make them better and more useful citizens than the great majority of the ragged and shoeless who now swarm in our streets.

The giving of lectures is certainly a valuable mode of creating interest and assisting those who wish to study the

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various collections, but great tact is necessary to prevent lectures from being failures. Many a would-be student or museum visitor may be disheartened by an uninteresting lecture or lecturer, notwithstanding that all the facts stated may be as accurate as possible. Those who are appointed to lecture should not only possess the requisite knowledge, but be capable of saying all they say in a plain and thoroughly interesting manner. It may be even advantageous to have two classes of lectures, viz., such as are intended to create and cultivate the taste, and others for more advanced students; and, as far as possible, the objects spoken of should be clearly seen by the audience or be well illustrated in some manner. Much attention is also necessary to the selection of the time when they are given, so as to allow those to whom they may be serviceable to take advantage of them.

Then again, as regards *viva voce* information, it seems to us desirable that there should be more frequently present attendants who can properly describe the exhibits. It is all very well to have attendants who can keep order and prevent damage to the objects and buildings; but there would be more interest shown if there were always some person at hand who could assist visitors by giving information. Most of our curators are too busily engaged in the duties of collecting and arranging to be able to give much time to visitors, and the usual attendant is the ordinary policeman.

But probably the most useful aid in visiting a museum is a trustworthy, easily-to-be-understood handbook, to which the visitors might refer at leisure; but many of our museums are, as we mentioned in our first number, destitute of handbooks of any kind, and it is highly desirable that the want should be speedily supplied. The example of the Birmingham Museum and Art Gallery may well be followed in this respect, and the remarks of the able director of that Institution, Mr. Whitworth Wallis, at the Art Congress, urging the issue of cheap descriptive catalogues and penny handbooks, and the labelling and description of objects in language not too abstruse, are worthy of the most serious attention.

And, further, there is the great question of having the museums open at such times as they can be most freely used by the people. We do not intend here to enter on the subject of Sunday opening, although we may say, in passing, that we do not anticipate from such action the evils which the opponents of such a course so strongly urge, but, on the other hand, we believe that very much good would result. It is, however, too often the case that many museums are closed in the evenings of week days and at other times when they could be well made use of by the general public.

But all these measures must be of little avail where collections are ill arranged, in bad condition of preservation, and not kept up to the present state of our knowledge; yet we fear there are many museums where the arrangement is unsystematic and antiquated, where specimens have so changed as to be quite unrecognisable, and where there are many gaps that might be readily and advantageously filled.

We hope the increased interest in museum work now shown may lead to a rapid decrease in the number of such ill-arranged and badly-managed places, and that all our museums may quickly become centres of intellectual activity, and aid more than they have hitherto done in raising the standard of thought and action amongst the masses.

Theories of Mountain Formation.

By T. Mellard Reade, C.E., F.G.S., F.R.I.B.A.

Part V.

(Conclusion).

THE relations between volcanic energy and mountain formation are undoubtedly intimate, yet the prevalent ideas on the subject are characterised by obscurity.

Unfortunately phrases so often do duty for thought, that it behoves every geological student to ask himself as he goes along whether the explanations offered of phenomena are really such, or merely resolve themselves into involuntary attempts to elude difficulties. Among these latter I would class the notion recently resuscitated that the sinking of the great ocean basins has thrown up the marginal deposits into mountain chains. A very slight acquaintance with geometry is sufficient to show that the lateral thrust which, on the most favourable supposition, could be produced in this way is infinitesimal. Take the Atlantic as 2,000 miles wide and three miles maximum depth, what thrust could this exert on the shore lines. even if the bottom sank the whole depth in a hundred years? The depth of the inverted arch or segment is less than $\frac{1}{666}$ of the span, and would be represented by a deflection of one inch in a girder of 50 feet span; yet a deflection of this amount would probably have to be repeated thousands of times before the stability of the terminal supports of such a girder would be greatly affected. Notwithstanding this, we are asked to believe that the folds of the Appalachians have been produced by the sinking of the Atlantic bed. If the whole three miles of depression were converted into lateral thrust it would be insufficient. If, on the other hand, the holders of this theory imagine that the Atlantic bottom rests on a semi-fluid mass of molten matter, which it displaces and throws up on its margins—an assumption for which there is no warrant at all, either physical or geological—we can only say that the structure of mountain chains negatives any such an explanation of their origin.

Volcanic energy is, in my view, another form or manifestation of the forces which, under favourable conditions, give rise to the expansions of the crust of the earth, which end in the production of a mountain chain. Volcanoes are surface manifestations of this force, and any one who wishes to study the subject from this, the first point of view, had better read Scrope's classic *Volcanoes* and the interesting treatise by Professor Judd bearing the same title, published in the International Scientific Series.

There is, however, one aspect of the question which has hardly yet received the attention it deserves. It seems pretty conclusive that volcanic energy could not have continued active from the dawn of geological history unless it were connected with the central heat. Hopkin's and Lyell's suggestions that volcanoes may be fed from isolated lakes of molten rock in the earth's crust does not commend itself to my mind, unless these lakes are themselves fed from the central reservoir.

No explanation of volcanic emission which does not provide for getting the molten rock from a depth of from 20 to 30 miles is complete.

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In the first place, molten lava stands in the throat of a volcano in some cases 12,000 feet above the sea level, and with such a "hydraulic head," unless it were fed from some deep-seated source, the column would diffuse itself over the edge of the reservoir, in the same way that a man empties himself by blowing down the tube of a pneumatic bellows. The column of molten lava must, to maintain stable equilibrium, be supported by the same weight; but, if these columns be cavi[illegible] the plasticity of the fluid lava will account for [illegible] 12,000 feet above the sea. Unless the [illegible] is solid or nearly solid at its origin, it seems impossible to account for the phenomenon of intermittent emission at the surface; for, were the whole column of lava fluid, and fed from a [illegible] reservoir, any relief of the covering rock would produce continuous instead of intermittent ejection took place, instead of that intermittent [illegible] the regular, or rather irregular, mode in which [illegible] itself.

[illegible] report to the Royal Society on the eruption of Mount [illegible] that when the mixtures of silicates of which the Krakatoa lava consists meet with water, then very fusible glasses are formed. From this Professor Judd infers that the slow percolation of water [illegible] from above, and the consequent formation of new [illegible] acted upon by subterranean heat, is [illegible] volcanic action. These interesting discoveries throw [illegible] on the immediate manifestations of volcanic energy, but [illegible] explanation, and do not account for the pumping up of the [illegible] matter of the globe from below what is called the "[illegible]." Unless there were, as I pointed out at the commencement of this article, a continual renewal of incandescent matter from [illegible] in the millions of ages that have elapsed since the [illegible] volcanic energy would have died out, whereas, according to the best geologists, it is potentially as active now as ever.

It is a very remarkable fact, that frequently in great ranges of mountains the [illegible] has been penetrated by igneous dykes [illegible] the elevation of the range, and volcanic cones have been built upon the highest points. This holds good with the Caucasus, where [illegible] which took place at the close of the Tertiary epoch [illegible] to it, have only exercised a local effect on the [illegible]. The most notable cone and the highest point of Europe, Mount Elburz, stands in the midst of crystalline [illegible] at the point where the chain reaches its greatest width. We may not unnaturally ask ourselves why volcanic action should manifest itself specially in this way, rather than that the lava should break out at lower levels? It would seem to point to the persistence of a [illegible], or effect of heat, under the range, remnants of the heat energies which originally, by expansion of the heavy overlying sediments which [illegible] them up, gave rise to the range.

Volcanic action has, in one form or another, always been present during the building of mountain ranges. The sedimentary beds are often interstratified with lava flows of great thickness, and seemingly the combined sediments and lava sheets have had to be piled up to a great thickness before the energies necessary for mountain building have accumulated sufficiently to initiate mountain movements. That this has been the case we see a good example in our own Snowdon, where the sheets of trappean rock partake of the folds of the mountain equally with the sedimentary beds. From this it would appear that where there has been great surface emission there has not been contemporary mountain building—except in a plateau-like form, as in the Deccan in India and Colorado in North America. If, as I infer, mountain building and volcanic action are different results of the same heat energies, it follows that where there is easy surface overflow there cannot be that intense folding and crushing which are the predominant characteristics of a great mountain range.

Our direct knowledge of volcanic action is limited to surface phenomena. Mechanical knowledge almost as certainly leads to the inference that it is really deep-seated. We cannot say what takes place in the laboratory of nature 30 miles below our feet, but that variations and long pulsations of temperature take place we must reasonably suppose. We have seen that the piling up of sediments is one cause of this, but doubtless there are others we can only dimly guess at. Emission at the surface of molten lava will produce a movement of fresh magma towards the base of the column or pipe: this means a renewal or accession of heat, and it also means further chemical reaction and melting of surrounding rocks. Expansion in volume of this magma, be it ever so minute, will show in the volcanic column like the mercury in a thermometer. Doubtless there are reservoirs of lava in the solid crust itself fed from the nucleus, and an alteration of volume in the solid surrounding rock, such as accompanies a small change of temperature, will affect the lava column in the same way as an alteration of the bulk of the molten matter of the reservoir itself.

The late Mr. Mallet considered volcanic action to be due to the crushing in of the crust of the earth following upon secular refrigeration, and his theory was therefore on the same basis as the "contraction" theory of mountain formation. If, however, this theory is incapable of explaining mountain upheaval, still less can it account for volcanic action; for, as is shown by the investigations of the depth of the "level-of-no-strain" crushing ceases a few miles below the surface. Volcanic action, as already shown, is initially due to [illegible] lava flows must be fed from a zone of the earth at depth [illegible] within the contracting magma. Now, as contracting matter does not force itself up to the surface, we must look to other agencies for the pushing up of the incandescent matter of the interior, which only becomes molten by the relief of pressure on making the surface. This force is to be found, I believe, in variations of temperature, which increase the local bulk of particular sections of the earth.

The problems discussed in these series of articles are of a very difficult nature. They demand a great variety of knowledge on the part of him who would investigate them.

First and foremost, to [illegible] which the question as to [illegible] demands the possession of a [illegible] acquaintance with mechanics, though [illegible], is of itself insufficient. A real living [illegible] with the sort of forces to be dealt with, boards of a [illegible] with mechanical difficulties, seem to me [illegible]. Chief of all, however, is it necessary to study the [illegible] nature, not only in the field but in the works of those geologists who have devoted themselves to the unravelling of the earth's secrets. The successful investigator must sail very close to the facts of nature: he must never lose sight of them, but continually square his theories with them. Nothing is easier than to elaborate a system of cosmogony in the closet, starting from some simple axiom; but a theorist of this kind very soon parts company with fact and nature, and sails off on an imaginary cruise on his own account. Like Fuseli, the painter, who is reported to have said of himself—"Nature puts me out," such a theorist draws his pictures, and eventually his facts also, from the stores of his inner consciousness. Our theories should be explanations of what we see, not *a priori* possibilities.

It is the great glory of geology that it brings into strong action common sense and sound judgment, and it has always seemed to me to be a science specially adapted to the English mind. Be this as it may, there is scope in it for the profoundest practical and theoretical knowledge. The more we labour the more oppressive the feeling of our own inefficiency becomes; but, at the same time, if progress be slow there is great satisfaction in feeling that one has contributed a stone or two to the great cairn of truth. Whether such contributions are contained in these articles it will be for time and the labour of others to tell. The investigations upon which they are founded have, at all events,

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enlarged my own horizon and given me a clearer conception of some of the processes of nature; and, if this be the case, I venture to hope that others also may derive some benefit from following the same mental processes.

True and False Dew.

By Dr. McPherson, F.R.S.E.

If the leaves of the common broccoli be examined in the morning, after a mild, dewy night, brilliant globules will be found, at short distances apart, along the very edge of the leaves, while a pearly lustre, varnished in filmy humidity, is spread over a great part of the surface of the leaves. The former drops have always been called dew-drops: the latter particles have passed unnamed. But our readers will be rather startled when they are informed that the globules, which, all a tremble with the gold morning light, attract the attention of the most ordinary observer in the country, are not dew-drops at all, but that the true dew is just the minute particles spread over the leaves. Yet such is the case. Science has attacked poetry in one of her most beautiful images; with merciless coolness the scientist scatters the poet's dreams.

A more careful observation of several plants corroborates what is best seen in the broccoli. Certain kinds of garden plants are covered with moisture, while others are quite dry. In clusters of one kind of plant, some leaves are studded with the diamond drops round the edges or at the tips, while other leaves show no signs of the truth of Ballantine's line, "Ilka blade o' grass keps its ain drap o' dew;" for they possess no moisture at all. The very dry leaves are found to be unhealthy, sickly, and with scant signs of vitality; whereas the drop-scattered leaves are in vigorous growth and of a rich, healthy colour. This fact gave Mr. John Aitken, F.R.S.E., the key to the solution of the problem. The drops are only evidence of the plant's vitality, and not dew at all. He saw decayed leaves that lay on the ground all around with no large drops similar to those on the healthy, living plants; though he frequently saw, after a dewy night, the lustrous film over them. Whatever the pearly moisture was, and wherever it came from, were other questions; now he was sure that it was not the same as the larger drops.

Dr. Wells—the great authority on the formation of dew in the beginning of the century, and whose book on the subject will repay a most careful perusal—had hinted something about the transpired humour of the plants. Musschenbroek, too, had regarded these big drops and small particles alike as a real perspiration of plants. Dr. J. W. Mool studied the subject, and spent a considerable time on this part of the physiology of plants, to ascertain if plants exuded moisture. A strong light placed behind a broccoli leaf reveals the fact that the drops are at the extremities of the nearly colourless and semi-transparent veins of the leaf. The beautifully-sparkling globules are at the points where the leaf-veins come to the outer edge. The veins of the leaf are the channels from which what were once considered the dew-drops are expelled; the drops are not dew at all, but only the natural juices exuded in the process of growth by healthy plants.

Mr. Aitken, with exemplary assiduity and characteristic patience, tested the accuracy of his conclusions in a series of beautiful experiments. He selected a small turf, placed over it a glass receiver, and left it till drops were exuded. Then he removed the receiver, and selected a blade of rich green grass, bearing a beautiful crystal like drop. He did not remove it, but he carefully wiped off the drop and dried the leaf: he was satisfied this was a healthy leaf. Next, he placed the tip of this leaf into a small glass receiver, so as to keep it entirely free from the action of the damp air in the larger vessel. The open end of this small receiver was closed by means of a thin metal plate cemented to it; but a fine slit was made in the centre of the plate, through which he had passed the leaf for examination. The large glass receiver was then placed over all. To realise the beauty of this experiment, you must bear in mind that the grass of the turf was growing healthily on the earth which had been removed with the turf, that all the leaves except one were exposed to the damp air in the large vessel, but that the one clean leaf under observation was carefully isolated in the small receiver, which was destitute of damp air.

After some hours a drop was formed on the tip of the isolated blade. This could not have come from the air; it could only have been exuded from the leaf. But more, the healthy leaves in the large receiver had also drops of the same size as the drop on the blade which was isolated; accordingly these drops, too, were not dew-drops, but the mere excreta of the blades. Hundreds of observations were made with the same results by this indefatigable scientist. He varied the nature of the experiments, yet the conclusion was the same. He was especially struck with the fact that plants with narrow, pointed leaves, like those of grass, were nearly covered with the filmy moisture; this showed that narrow leaves are bad attracters of real dew. This he verified by exposing broad surfaces of glass and narrow strips of glass on a dewy night; in the morning he found the sheets of glass dripping with wet and the narrow strips quite dry. The surfaces of leaves which showed the exuded drops best were not wetted by water.

Still further to investigate the subject, he took a hint from Dr. Mool's method of substituting for root-pressure in plants a pressure produced by a column of mercury. Only, instead of mercury, Mr. Aitken used water. He connected a leaf of broccoli, by means of an india-rubber tube, with a head of water, of about forty inches, the water having been coloured, as in ordinary injection processes, with aniline blue. The pressure accelerated the growth processes, and the coloured water was quickly forced through the veins of the leaf. When the drops first appeared at the edges, through the extremities of the veins, they were colourless; they consisted of the moisture in the veins before the pressure was applied. Soon, however, the small drops increased in size and showed slightly blue tints; and at length the whole leaf became coloured of a fine deep blue-green, like that seen when vegetation is very rank. The formation of drops on plants that exude moisture depends on the rate of supply, the humidity of the air, and the velocity of the wind. The fact remains, however, that the drops which first appear on dewy nights are not dew at all; and their appearance depends more on the laws of vegetation than on those of dew. Many a time, when walking in the early morning over the wet meadows, it is not dew we brush off the grass with our feet, but the sap exuded by the healthy plants themselves. This can be tested, for this moisture can be seen on many nights when there is no deposit of dew at all. In fact, on all nights, when strong vitality is observable in the vegetable functions, *before the true dew* is deposited, these drops of exuded moisture (or *false dew*) are seen on the tips of the blades of grass.

The practised eye can easily discern the difference between the true dew on grass and the drops exuded through the blade veins. These drops are always formed at the extremities of veins near the tip of the blade, and are of some size; whereas the real dew is distributed all over the blade in a moist film. The false dew forms large diamond-drops from the plant's life-blood; the true dew covers the blade with a fine pearly lustre. Brilliant globules are produced by the vital action of the plant—the liquid being the *elixir vitæ* of vegetation—showing life in one of the most charming forms in the phenomena of nature; while the lustrous particles of moisture are formed over the blades by that wondrous alchemy which transforms the water-vapour *rising from* the bosom of mother earth into the plant-refreshing dew, "which kept the face of Eden green before the useful trouble of the rain." We say "rising" from the earth; but to explain the new theory of the formation of dew will require another article.

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Scientific Aspects of Health Resorts.

IV.—The Valley of the Tay.

(Concluded from page 85.)

THE Falls of Tummel present features of quite another character to those just mentioned. Their height is not more than about eighteen or twenty feet, but their peculiar shape, the great rush of water, and the many forms of action exerted by the numerous whirling eddies on the rocks in and about them render them peculiarly interesting, whilst the surrounding scenery is worth visiting for itself alone. These falls are easily reached by a short walk from the Bridge of Garry over the lower part of the Pass of Killicrankie, or by a somewhat more arduous route by way of the Bridge of Cluny and Port-na-Craig, and by a road which reaches to the south side of Loch Tummel, one of the most beautiful bits of lake scenery in these parts. It is best seen from what is termed the "Queen's View," which can also be reached from Pitlochry by a pleasant walk or drive of about eight miles, round by the Bridge of Garry, and a rather uphill road past the path leading to the Falls. The loch is only about three miles in length, and at no part more than half a mile in breadth, but it is a lovely sheet of water, surrounded by beautiful woods and green slopes, and altogether forms a picture not easily forgotten.

THE FALLS OF TUMMEL.

The river Tummel, which issues from the loch, presents great contrasts in its upper and lower reaches. Above its confluence with the Garry it presents one continuous scene of impetuous water, rushing through a narrow and wooded glen, with numerous rapids and cascades; but between the confluence and Loch Tay into which it pours its waters it is a wide and grand stream, passing with steady flow through a wide and well-cultivated valley. Loch Rannoch is another loch worthy of a visit, and between it and Loch Tummel flows the river Rannoch, another rapid and impetuous stream, but probably not with scenery equal to that of the Tummel. About four miles from Loch Rannoch it forces its way through the remarkable Pass of Schichallion.

The valley of the Tay itself—that is, the river which flows out of Loch Tay—presents many examples of fine scenery. All the way from Kenmore to the junction with the Tummel, and on to Dunkeld, a distance of about twenty-five miles, the vale is one continued scene of great beauty, with the river flowing as a fine broad stream through a well-wooded and highly-cultivated country, bounded by lofty mountains with many forms of outline, and presenting many diversities of picturesque scenery.

And below Dunkeld, through the Pass of Birnam, and onwards to the estuary and the sea, there is still maintained much scenic beauty worth notice in regard to the causes which have produced it.

In connection with the geology of this part of the river course, the views of Professor Geikie* are worthy of careful note. He says, "The Tay issues from the Highlands by the narrow defile of Birnam, and crosses without deflection the line of the great boundary fault. It then winds across the old red sandstone gneiss as far as Perth, where the ridge of the Ochil Hills runs on into that of the Sidlaws. Instead, however, of circling round this ridge, the river continues its course right across it, and then bends to the east and enters the Firth. Its tributary, the Earn, a little way farther south, likewise cuts through the same ridge. The careful mapping of the Geological Survey has detected evidence of a probable fissure in the defile of the Earn, the upper old red sandstone being there brought down against the older volcanic rocks. The gorge of the Tay, however, appears to be entirely due to erosion by the stream itself." And he then goes on to put the question—"If, then, the chain of the Sidlaws once ran unbroken to the south-west, through the hills of Kinmore and Moncrieff, into the range of the Ochils, of which, geologically, it is a prolongation, how could the Tay trench it?" And, after discussing other possible explanations, he gives his own views, as follows:—"Looking at the facts in connection with the whole problem of the denudation of the country, I believe that we must regard the trenching of the Ochil ridge to have

* "Scenery of Scotland Viewed in Connection with its Physical Geology," pp. 346, 347.—*Macmillan & Co., London.*

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been begun before the ridge had as yet appeared. We must carry our imagination back to that immensely remote period when the present broad valley between the Ochil and Sidlaw range on the one side, and the Grampians on the other, was filled up with old red sandstone, and when the Tay began to flow in a depression of the sandstone plain. The river gradually worked its way downward through this sandstone covering. How far, when the river began its operations, the top of the anticline had been levelled off cannot be known. But the igneous rocks, if exposed at the surface, could not have formed a continuous ridge, for the river flowed across their site. At the same time, the whole surface of the country was lowered by denudation. The sandstones, being more easily removed, were lowered faster than the volcanic rocks. Hence the former were worn down into a plain, and the latter were left protruding as a ridge. But the river, having meanwhile taken its course across the line of the ridge, continued to saw it through as it emerged from the general degradation of the land."

A Weeping Birch at Dunkeld.

We should like to refer to several other localities on the Tay and its tributaries, but have not sufficient space left. We may, however, safely say that few river systems afford opportunities for scientific study in so many directions. With regard to the geological details of such inquiries there can be no better guide than Professor Geikie's book, from which we have just quoted. It is an excellent work for students of natural scenery, and contains many references to the Tay and its tributaries.

There is another inquiry that in the writer's opinion would prove interesting, viz., the nature of the more microscopic life of the several lakes and streams. Such inquiries, although they have not been pursued to any great extent, have always resulted in the discovery of many interesting facts, and may well be followed up with reference to the use of the waters of lakes and streams for ordinary water supply. And we cannot conclude without calling attention to the great beauty of many of the trees in this district. Excellently well nourished by the natural conditions of moisture, soil, and atmosphere they exhibit forms of much loveliness; and if we may speak of one variety as more beautiful than another we may mention the birches which are often very fine both in form and foliage. One of these is shown in our illustration. And as with the trees so with more lowly forms of vegetation, which in very many parts of both the higher and lower reaches of the Tay system, add much beauty to what otherwise is charming and interesting, and thus does the valley of the Tay and its tributaries not only become of interest to the scientific student of natural scenery, but can claim and well occupy the attention of the artist and lover of the beautiful in nature.

Colour Blindness in its Relation to the Mercantile Marine.

In an article in our November number colour blindness was referred to from a general point of view, but we now wish to show how important is the study of the subject in connection with special occupations.

The majority of persons afflicted with colour blindness may go through life without experiencing much inconvenience themselves, or subjecting those with whom they are brought in contact to any great risk or hardship; but it will be admitted that there some callings to which a lack of power to discriminate between colours should prove an insurmountable barrier. We have but to think of the thousands of lives and millions of property continually in transit on the sea to realise what serious consequences might arise if an officer or "look out" were unable to distinguish the colours of the lights carried by vessels at sea.

Of 32,165 men tested by Holmgren for this visual defect, 1,010, or 3·168 per cent. were colour blind. Dr. Joy Jeffries discovered among 10,387 examined by him that 431, or 4·149 per cent. suffered from colour blindness; while the London Committee found among 14,876 tested that 617, or 4·150 had defective colour vision. The average percentage of colour blindness among males, as established by these reliable authorities, is thus 3·824. We may reasonably assume that the percentage of colour blind subjects among seamen is the same as that of any other community of males. By the census of 1881 the total number of sailors employed in the mercantile marine service of the British Islands, exclusive of pilots and canal and lighter men, was 120,122. Taking 3·824 as the percentage of this number afflicted with colour blindness, we have a total of 4,593 colour-blind men holding positions, in very many of which correct colour discrimination is absolutely necessary. This state of things should never have arisen. It was not until 1877 that the Board of Trade acted upon the representations of the ophthalmic section of the medical profession, and passed the resolution "that all candidates for examination for masters' or mates' certificates shall pass a test examination as to their ability to distinguish white, red, green, yellow, and blue." The resolution goes on to state "that the Board have been led to this decision because of the serious consequences which might arise from an officer of any vessel being unable to distinguish the colour of the lights and flags which are carried by vessels."

This feeble attempt to legislate upon a most important question is utterly behind the times. According to present regulations, a lad may enter the merchant service, serve a four years' apprenticeship, and then be examined for his Board of Trade masters' certificate. He may then discover that he is colour blind, and therefore debarred from following a profession he should never have embraced. Cases of this character

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are unhappily on record. Instead of the defect being discovered at the outset of the sailors' career, he is allowed to master the drudgery of his business, and just as he is about to reap the reward of his labours, he is prevented from doing so by his congenital ailment, and he finds himself starting life again totally unfitted, by taste and the free sailor's life he has been leading, for any sedentary calling. Of course he could have availed himself of the voluntary test, but who ever dreams of being colour-blind?

But this is not the only evil of the present system. Many candidates for officers' certificates who are rejected for colour blindness simply "go up" again, taking care, however, to change the venue of their examination. Thus we have it on record that a man who fails at London, may on a subsequent trial pass at Cardiff, Liverpool, &c. During the five years ending May, 1884, the Board of Trade rejected 85 of those who presented themselves for examination, as being unable to pass the colour test. Of these 85, 46 never applied again; 31 applied again and passed, while the remaining 8, after failing twice, did not apply a third time. Now, as colour blindness of a decided form is congenital, and congenital colour blindness is undoubtedly incurable, it follows either that the 31 who were first rejected and subsequently passed were not colour-blind, or that there are officers in our merchant service who suffer from colour blindness.

For ordinary seamen there is no compulsory test, although a ship with her crew, passengers, cargo and freight incurs a frightful risk each time a colour-blind seaman is employed on the "look-out" The regulation side-lights carried by vessels at sea should be recognised in clear weather at a distance of two miles, so that two vessels approaching each other at night can get no definite idea of each other's relative position until there is but two miles between them. Suppose two steamers, each nearing the other at the rate of twenty miles an hour, in three minutes' from the moment that their respective side-lights are clearly discerned they will either have safely passed or else have met in a disastrous collision. At such a time the slightest hesitation or incompetence of the "look-out" may produce a most dreadful calamity. Many a catastrophe of the sea ascribed to "imperfect look out" may without doubt be owing to imperfect colour vision among able seamen.

One great steamship company, the Orient Line, fully grasping the importance of the situation, have had their deck hands tested with a view to testing whether any were unable to discriminate between red and green in the degree requisite for safe navigation. Of 320 men examined at Tilbury Docks between January and May last, no less than 16, or 5 per cent., showed, by their inability to distinguish between red and green, their unfitness for their vocation. The reasonable probability is, that out of every hundred men employed on the ships of all the other companies to keep a look-out by night, five of them are physically disqualified for the efficient discharge of this most momentous duty. Among the rejected candidates who came before the Board of Trade during the twelve months preceding May of this year, was a man who had been eighteen years at sea, and yet, when put to the test, described a pink cord as blue, and drab as green. Various shades of green and yellow he pronounced to be red, and different shades of neutral tint and of blue he classed altogether as green. A man thirty-three years of age, who had been fourteen years at sea, and aspired to become second mate of a vessel, pointed out standard green as a red, and standard red as green. Bottle green he took to be red, and pale blue as red and green. It may be presumed that none of the men examined were fully aware of their visual deficiency, and probably few had the slightest suspicion of their visual shortcomings. Colour blindness is not very easily tested. A man who is blind to red may nevertheless manage to distinguish between a green and a red light shown simultaneously and with equal illumination, by the apparent superior brilliancy of the green. But his power to do this, though it may ordinarily disguise his infirmity even from himself, will not in the least enable him to pronounce upon the colour of a single light. It is to be hoped that the other important shipping companies may soon follow the praiseworthy example of the Orient Steam Navigation Company in requiring all their deck hands to pass the colour test.

Another happy sign of the times is to be found in the recent successful termination of a uniform system of buoyage around our coasts. The Trinity House Corporation, assisted by representatives of the Admiralty, Board of Trade, Irish and Scotch Lighthouse Boards, Rivers Thames, Mersey, Humber, Clyde, and Tay, have substituted in place of chaos a simple plan of buoyage, in which shape, and not colour, reigns supreme.

The detection of colour blindness in seamen is of such vital importance that it should not be optional as to whether a solitary shipping company choose to adopt a compulsory test among their men, but the test should be rigorously enforced by international legislation, for no matter how perfect the 'look-out" kept, or how thorough the discipline maintained on board a vessel, the vessel cannot be expected to enjoy absolute immunity from collision while other ships are allowed to sail the seas provided with incompetent "look-outs." All the great maritime powers save ourselves have long since realised how imperative it is that all those who follow the responsible calling of a pilot should possess accurate vision for colour. In Great Britain pilots are not tested for colour blindness, but though they may be physically incompetent are allowed to take supreme charge of vessels in the dangerous channels and estuaries of our coasts.

It is high time that our legislature paid some attention to this subject, and provided more efficient means to minimize the dangers to which the sea-going community, irrespective of travellers, are rendered liable through the employment of colour-blind seamen and pilots.

RICHARD HOLLAND.

Local Museums.

V.—Manchester.

UNTIL recently this important city was not possessed of a scientific Museum worthy of its position in the North of England. At the neighbouring borough of Salford, a fine Museum, Library, and Art Gallery was initiated in 1849, of which we purpose to treat in a subsequent article. Previously to this date, however, all that the City of Manchester itself could show for a museum was contained in the collections of the Natural History and Geological Societies—first housed in Faulkner Street, afterwards transferred to Mosley Street, and eventually to a building in Peter Street, where the geological collections of the two societies were amalgamated. In 1873, by general agreement, the collections were handed over to the Council of the Owens College, under certain necessary stipulations as to maintenance and care, and the provision of a fitting building for the treasures. That the undertaking then given has been faithfully carried out by the authorities of Owens College is apparent to all who now visit the fine building erected in Oxford Street, Manchester. A very large sum of money has been expended on fitting up the portion devoted to the Museum, and from time to time, by gift and bequest, large additions have been made to the original collections.

Before entering the building, visitors will see in the quadrangle of the College specimens which could hardly be exhibited indoors. These consist of a good representative series of boulders from the glacial beds of the neighbourhood, mostly of small size, but pre-eminent among them stands the famous Oxford Street boulder, a gigantic block of andesite weighing upwards of twenty tons, which was found a few months ago in a sewer cutting, and secured for the Museum by an appeal to the Mayor and Corporation of the city.

Entering the building by the laboratory entrance, the visitor is introduced in logical sequence to all the objects exhibited, commencing

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with minerals as representing the raw material out of which, directly or indirectly, all the varied forms, organic or inorganic, have been built up. The mineral collection has for its basis the specimens brought from the old Museum in Peter Street, but to these have been added specimens bought from time to time, such as the magnificent Cumberland calcites and the collection of the late David Forbes, F.R.S., a Manxman, and one of the foremost practical mineralogists of his day. The next section is devoted to chemical and dynamical geology. Then follows an extensive series of aqueous, metamorphic, and igneous rocks, covering in a very thorough manner the whole range of petrology. This branch of geology is illustrated to suit the needs of modern petrology by means of frames fitted to the windows, in which are placed side by side thin slices of typical rocks, and photographic transparencies of photo-micrographs of the same sections. These are so placed that high power hand lenses may be brought to bear upon the sections. A fine series of specimens from Vesuvius and the volcanoes of Auvergne, as examples of volcanic products, completes the mineralogical and petrographical record.

The stratigraphical series commences with a selection of Archæan rocks from all the principal British and a large number of foreign localities. The Cambrian and Silurian fossils are mainly drawn from the Lightbody and Homfray collections, and there are among them many type specimens. The Devonian and Old Red Sandstone faunas are represented by fish remains, presented by Professor Williamson and Mr. Edward, of Leigh. The life remains of the carboniferous period make an imposing array in the Museum, occupying eight large cases, and, as it were, overflowing into two plantations of large trees. One of these trees, a nearly perfect stigmaria, forms by far the most striking feature in the whole Museum. It was found two years ago at Clayton, in Yorkshire, and was presented to the Museum. Professor Williamson has written a monograph for the Palæontographical Society upon the specimen, in which he triumphantly vindicates the accuracy of the views of those English palæophytologists who have maintained that stigmaria was merely the root of a lepidodendroid tree, and that it branched by dichotomy to the third sub-division, after which, no matter to what length the roots might extend, they sub-divided no more. The collection of boulders from the coal is the finest in the kingdom, and includes a remarkable granite boulder, upon which Professor Bonney has furnished an interesting note to a paper on these remarkable erratics by Mr. Mark Stirrup.

The Permian, Trias and Rhætic, and Lias collections present no very special features, except a Lias Ichthyosaurus of unusual size. The Oolitic series is very well represented, and includes a set of plants from the Yorkshire coast. To illustrate the formation of the Jurassic coral reefs, an interesting series of specimens is shown from a modern coral reef. In the cretaceous cases, the sponges from the Toulmin Smith collection are particularly worthy of attention. There is here also to be seen a fine series of fishes from the cretaceous rocks of Brazil. The arrangement of the Tertiary and Post-tertiary collections is not yet completed. It contains mammalian remains and relics of early man from the collection of Professor Dawkins; and a collection of continental tertiary fossils presented by Mr. A. W. Waters.

The Zoological collections are slowly but steadily emerging from the chaotic state in which they have lain so long, and in the mammalian gallery substantial evidence is before the public of the work of preparation which has been quietly in progress for several years past. Skeletons and skulls are there in plenty, but stuffed animals are few and far between, so that those visitors will be disappointed who cherish the belief that a museum ought to be a kind of dead menagerie, "several acres of Noah's ark," as Professor Huxley styled a certain national institution not a great distance from Hyde Park. The few stuffed animals which have been admitted are, however, fair specimens of the art of the taxidermist. Coloured drawings of the animals are to be placed alongside the skeletons, and may be expected to give a far better impression of their actual appearance than could be conveyed by their stuffed skins.

The Zoological collections are thus by no means complete, but in a room off the top gallery devoted to British zoology will be grouped representatives of all the orders of the animal kingdom occurring in the British area, and, as far as possible, every genus and species. Another room will be set apart for a botanical collection.

A feature of the Manchester Museum which is being most assiduously cultivated is the abundance of illustrations. Thus, restorations of fossil plants, and well-executed drawings of their modern representatives, convey a much clearer idea to the lay mind of the carboniferous and Jurassic forests than could be gained by looking at thousands of calamites and "fossil birds' nests." Many animals, too, have been restored in drawings exhibited in the cases. A useful feature is seen in the cases devoted to stratigraphical geology, where maps are placed in pairs, one showing the actual outcrops of rocks belonging to a particular period, and the other "restoring" the British or north-west European geography of the period. The latter series of maps, based partly upon positive evidence and partly upon negative, must be taken only as approximations to the truth. Students of glacial geology will find in the Museum the nucleus of a collection of rock specimens from boulders, and the beginnings of a reference collection of Lake District rocks, which, as it expands, cannot fail to be of great service in the identification of boulders.

With boulder committees working in the neighbourhood, and such a central depository for the rocks, very valuable work might be done upon the much-vexed glacial questions; and if a federation of the Lancashire geologists could meet from time to time to discuss and report upon this and other branches of Lancashire geology, great advantages would doubtless accrue to the science and its votaries.

The Museum is open to the public on Mondays, Tuesdays, and Saturdays, from 11 a.m. to 6 p.m., and is reserved for students on Wednesdays, Thursdays, and Fridays.

The Durham Salt District.

NEW SALT FIELD IN THE NORTH OF ENGLAND.

BY EDWARD WILSON, F.G.S.

Part II.—(*Concluded*).

IN the Durham district the salt is extracted from its bed by solution in the form of brine, as is also the great bulk of the salt of Cheshire and the whole of that of Staffordshire and Worcestershire.* The particular method, however, which is employed for raising the brine to the surface in this district differs from that which has been so long in use in those salt fields. This process, which has for some time past been in operation in the salt district of Nancy in France, and also in Wurtemberg, was introduced into England for the first time by Messrs. Bell Brothers at their Saltholme Works about twelve years ago. Briefly described the process is as follows:—A hole varying from six to eight or even twelve inches in diameter is bored down to and through the rock-salt. This is now almost invariably accomplished by the diamond rock-boring process, which is the most satisfactory one, on account of supplying a continuous series of cores of the strata passed through, as well as from being extremely expeditious in its operation. The hole thus bored is lined with a wrought-iron tube, used as a retaining tube; where this tube passes through the bed of rock salt it is pierced with two sets of apertures—an upper set coinciding with the upper part, and a lower set opposite the lower portion of the seam. Within this tube a second tube is placed, having a diameter of from two to four

* In the Durham district the rock-salt is invariably found to be firm and dry when first struck, and not associated with any natural brine springs or subterranean reservoirs, such as occur in the Cheshire and Worcestershire districts.

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inches less than the outer one, and this also is perforated with holes in its lower portion. Both tubes are properly secured below in the first hard bed underlying the rock-salt. Water is admitted to the *annulus* or space between the two tubes. At first a special supply was deemed necessary, but now the water derived from the overlying water-bearing beds is generally allowed to filter in. By means of the outer holes this water is allowed to come in contact with and dissolve the rock-salt. The brine thus formed finds its way into the inner tube, and rises as high in it as the column of fresh water in the outer tube will balance a column of a liquid having a specific gravity of 1·204, or thereabouts. The brine is drawn up the remaining height which is, of course, greater the deeper the well and the more concentrated the brine—by pumping. As it is raised fresh water flows in to take its place, and the process is continued. At first the salt dissolves very slowly, and for some months the quantity of brine which one of these wells yields is inconsiderable; but as time goes on, and the fresh water eats its way further into the rock-salt, increasing the area of solution, the salinity of the brine proportionately increases. On reaching the surface the brine is conveyed to a large reservoir. Here the earthy matter is allowed to settle, after which the clear brine is run into a series of evaporating pans. Beneath these heat is applied by burning small coal at one end, the products of combustion passing to the other end and escaping up a chimney at a temperature of from 500° to 700° F. At Messrs. Bell's and also at Messrs. Bolckow & Co.'s salt works, where there are also iron furnaces, the surplus supplies of heat from the hot-air blast are turned to account by being conveyed by flues under the salt pans. On the surface of the heated brine the salt crystallises, and every second day is fished out on to drainers, the brine running back into the pans. If required for soda making the brine is kept at a temperature of about 196° F. For the production of table salt evaporation is carried on at a higher temperature and much more rapidly, and the crystals are very minute and adhere closely together. For fishery purposes the crystals are prepared very coarse in size, and for this class of salt evaporation is conducted at a lower temperature and much more slowly than for the soda makers.

Now, although the system above described for raising the salt to the surface is by far the most economical, both as regards the capital and labour employed, and, indeed, the only system which, it is thought, with salt at its present cheap rates, could be remuneratively employed in a district like Durham, where the rock-salt lies at such very considerable depths, it is extremely wasteful, having regard to the proportion of the salt which is ultimately extracted from its bed, and is attended with other serious disadvantages. For it is found that these salt-wells will only yield a limited quantity of salt, and that after a time they become practically unproductive. This is apparently due to the insoluble earthy residue of the rock-salt which is left behind when the salt is dissolved, and also to falls of rotten marl from the roof. This in time forms a thick earthy film over the surface of the cavity eaten out of the salt-bed impervious to the action of fresh water. Thus by and by the brine gets weaker and weaker, until it eventually becomes too poor to raise. Again, there is evidence to show that by the above process the salt-bed is dissolved in a very irregular manner, namely, much more rapidly above than below, owing to the fact that the fresh water let down has a greater solvent action on the rock-salt than the denser brine upon which it floats. Hence it is found that the cavities eaten out of the rock-salt at the bottom of these wells take the form of flattish inverted cones. It is clear that, under this system, the subsidences which must eventually set in will be of a very irregular and damaging character to the surface properties. Up to the present, there does not appear to have been any trouble on this account in the Durham district, but, in the course of time, in the localities where the salt-bed is considerably honeycombed by these wells, subsidences are sure to take place, the consequence being that the surface will become pitted with funnel-shaped holes, roughly conforming in their contours to the subterranean cavities. Under the present laws, owners of land adjoining salt-wells, unlike owners of land undermined by coal-workings, have no legal claim for compensation for damage done to the surface, nor for the loss of the mineral which has been abstracted from beneath their property—a gross anomaly of the English law, and a very palpable injustice. These special evils would be avoided if salt were mined in the same manner, and in other respects treated like coal. If this were done, a much larger proportion of the thick salt-bed of South Durham might no doubt be extracted, as well as a good deal which lies beneath the sea; but whether it would, by any process, be practicable to remove the whole or even the greater portion of an immense mass of rock-salt 100 feet in thickness, and lying at depths of from 1,000 to 2,000 feet beneath the surface, is very doubtful, nor can one forecast the precise limits to the destruction which would result through subsidence, were such a thing done.

Although the South Durham salt-field has not up to the present time contributed a very large share of the total produce of the United Kingdom, the output from the district is considerable, and is rapidly increasing. In the year 1887 there were, according to Sir Lowthian Bell, no less than twenty wells in this district from which salt in the form of brine had been raised, although seven of those were then disabled through accidents. It is estimated that in that year these wells yielded very nearly 150,000 tons of salt, whilst the probable output for 1888 has been calculated at 200,000 tons. (See following table.) Possessing exceptional advantages in the proximity of the chemical works of the Tyne and adjoining district, the close contiguity to an important coal field, and, in addition to adequate railway accommodation, the presence of a convenient port for London and the foreign markets in its immediate vicinity, the Durham Salt Field is evidently destined to make great advances in the future. To the Tees Valley it is to be hoped we may specially look, to guarantee our supplies of salt for many years to come, and also to protect us from a monopoly, which, when we consider the absolute necessity of this mineral as an article of food, as well as the multifarious other uses to which it is put, would be nothing less than a national calamity.

ANNUAL PRODUCTION OF SALT IN GREAT BRITAIN.

DISTRICT.	1885. TONS.	1886. TONS.	1887. TONS.
Cheshire, Rock Salt	167,269	152,439	150,267
Do. Brine Salt	1,687,456	1,604,400	1,619,452
Cheshire—Total	1,854,725	1,756,839	1,769,719
Worcestershire, Brine Salt.	270,000	260,000	252,000
Durham, Brine Salt.....	53,937	98,562	136,267
Ireland, Rock Salt	23,211	21,009	30,155
Staffordshire, Brine Salt...	5,810	5,810	5,810
Total Production	2,207,683	2,142,220	2,193,951

BINGLEY TECHNICAL SCHOOL.—The ceremony of laying the corner-stone of Bingley Technical School took place on October 27th. There was a very large attendance. The secretary (Mr. A. Platts) read a list of subscriptions, which showed that £2,349 had been received. Of that sum Mr. Alfred Sharp had contributed £1,000, and the Cloth-workers' Company of London £200. Mr. A. Sharp then laid the corner-stone, and Sir Andrew Fairbairn, Mr. John Barran, M.P., and Mr. Swire Smith addressed the meeting. In the evening a public meeting was held in the Mechanics' Institute. The chair was occupied by Mr. Alfred Sharp, and among the speakers were Mr. Barran, M.P., Sir Henry Mitchell, Professor Bodington (Principal of the Yorkshire College), Mr. Swire Smith, &c.

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Our Portrait Gallery.

VII.—Mr. JAMES W. DAVIS, F.G.S., F.L.S., F.S.A., &c., A Yorkshire Geologist.

AMONGST that hard-working band of Yorkshire geologists who are doing so much to extend geological knowledge and promote research, the subject of our notice holds a commanding position. And not only in science does he rank so high, but as a public-spirited citizen, as an active man of business, and as an energetic organiser he also displays manifold talents. The science of geology was, a few years ago, little understood and appreciated in Yorkshire. Its students were looked upon as visionaries and theorists, and even accounted unorthodox and dangerous; but much has been done by Mr. Davis to dispel these misapprehensions and delusions. By his writings he has instructed the many, and by his frequent leadership of field excursions he has further made the science practical, and, at the same time, fascinating, by bringing enquirers and learners into immediate contact with Nature itself.

James W. Davis is descended from an old Gloucestershire family, which had for several generations been actively engaged in the dyeing of fabrics, and also in agriculture. A little over half a century ago the Davis family migrated into Yorkshire, where, in the neighbourhood of Leeds, the subject of this sketch was born on April 15th, 1846. As a schoolboy he early began to develop a taste for natural history. Leaving school at fourteen, he at once plunged into active scientific work. At this youthful age he was elected honorary secretary to the Leeds Naturalists' Society. The habits of method thus so early acquired, the aptitude for organisation thus increased, and the earnest and really practical field work thus commenced have all since been of the highest value. When eighteen, business changes necessitated his removal to Halifax, of which important town he is now one of its most popular, hard-working, and prominent citizens. Mr. Davis then began to concentrate his attention more especially upon geology, although he also devoted much time to archæological and antiquarian studies. In 1873 his efforts were rewarded by his election to the Fellowship of the Geological Society of London, to the *Quarterly Journal* of which Society he has contributed many valuable papers. The Linnæan Society and the Society of Antiquaries shortly afterwards conferred similar honours upon him. In 1876 his attention was drawn to the moribund state of the West Riding (now Yorkshire) Geological and Polytechnic Society, which seemed to be on the point of dissolution. The advent of Mr. Davis to the secretaryship changed this state of affairs, and, by incessant hard work and the application of his business capabilities, he raised it to a prosperous and useful position, extended the sphere of its operations to the whole of Yorkshire, and nearly quadrupled the number of members. At the Jubilee meeting of the Society, held last year at Ripon, the opportunity was taken to present Mr. Davis with some mark of the esteem in which he is personally held by the members, and also in some measure to recognise his great services as honorary secretary and editor of the *Annual Proceedings*.

Mr. Davis became a member of the British Association in 1873, and is a permanent member of the General Committee. Those who attend these meetings will remember the good work Mr. Davis accomplished in his careful investigation of the celebrated Raygill fissure in Craven. As secretary to the committee on pre-historic remains, and as chairman of the committee appointed to examine and report upon an ancient sea-beach near Bridlington, we confidently await the result of Mr. Davis's labours. Perhaps, in connection with the British Association, Mr. Davis's ichthyological researches are the most valuable. At the Belfast meeting in 1874 Mr. Davis was introduced to those famous palæontologists, the Earl of Enniskillen and Sir Philip Egerton. This led to a careful examination and study of their large collections of fossil fishes, and Mr. Davis's previous knowledge of comparative anatomy, and his predilection for fossil ichthyology have led him to make this branch of extinct animal life a special object of research. Amongst his contributions on fossil ichthyology to various scientific societies may be named the monographs published by the Royal Society of Dublin, viz.: "On the Fossil Fishes of the Mountain Limestone of Great Britain" (1883); "On the Fossil Fishes of the Chalk of Mount Lebanon and Syria" (1887); "On the Fossil Fishes of the Tertiary and Cretaceo-Tertiary Formations of New Zealand" (1888). Papers read by him upon this subject before the Geological, Linnæan, and Zoological Societies of London during the last five years are of acknowledged repute. It will be remembered that Dr. Henry Woodward, F.R.S., of the British Museum, spoke at Manchester in his capacity of President of the Geological Section. In his inaugural address, after briefly reviewing the monographs alluded to above, he said—"He is to be congratulated upon having contributed to fossil ichthyology one of the most extensive works published in recent years." Mr. Davis has recently visited, in the company of Mr. Arthur Smith Woodward, the most celebrated museums of the Continent to render himself still more conversant in his favourite study, so that we may expect some more contributions upon this special study from his pen.

The exertions of Mr. Davis in connection with that splendid scientific organization, the Yorkshire Naturalists' Union, must not be overlooked. As President of the Geological Section and as Chairman of the Executive his services have been invaluable. He is always ready with his practical experience to conduct arrangements or lead a field excursion; hence his presence and counsel are held in the highest appreciation by his brother scientists. Mr. Davis

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MR. JAMES W. DAVIS F.G.S., F.L.S., F.S.A., &C.

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has also taken a lively interest in educational matters in Yorkshire, particularly in connection with Mechanics' Institutions, which have done so much to promote education throughout the county for many years. He is an elected governor of the Yorkshire College (now affiliated with the Victoria University), and a member of its Textile (dyeing and weaving) Committee. He is likewise a governor of Heath Grammar School. He has been honorary curator of geology to the Literary and Philosophical Society for several years, and upon the Jubilee of the society in 1880 was elected to the position of President. During his term of office the museum has become a most valuable one for reference and study, and in the report of the British Association upon Provincial Museums it ranks as one of the first class. Mr. Davis possesses a splendid geological museum of his own at his seat, Chevinedge, which is acknowledged to contain one of the finest collections in Yorkshire. Mr. Davis has also been president for some years of the Halifax Geologists' Field Club and Scientific Society. As a member of the Halifax Town Council Mr. Davis has rendered signal service to the town. During his period of office he helped greatly towards the adoption of the Public Libraries' Act, and the town now possesses, chiefly through his exertions, a Public Library of 46,000 volumes, with a Fine Art Gallery and Museum attached. It is perhaps needless to add that he is the Chairman of the Public Library Committee. He has also been a member of the Halifax School Board for the past three years, and is Chairman of the Science Committee, which is doing good work.

Mr. Davis has also laboured hard for the promotion of the study of fine arts in Yorkshire, and his exertions as honorary secretary to the Yorkshire Fine Art Society for four or five years will be long and gratefully remembered. His own collection of water-colour drawings, which he has selected to illustrate the history of this art in Great Britain, is well known amongst the lovers of this particular branch of the fine arts.

S. A. A.

Art Congress at Liverpool.

THE first annual Congress of the newly-formed "National Association for the Advancement of Art and its Application to Industry" was opened in Liverpool on the 3rd December, under the presidency of Sir Frederick Leighton, who delivered the inaugural address in St. George's Hall. The following sections were constituted :— A. Painting (president, L. Alma Tadema); B. Sculpture (president, Alfred Gilbert); C. Architecture (president, Professor Aitchison); D. Applied Art (president, Walter Crane); E. Art History and Museums (president, Sidney Colvin); and F. National and Municipal Encouragement of Art (president, the Right Hon. J. A. Mundella, M.P.) It will thus be seen that the scheme of the association is sufficiently comprehensive, the objects being to discuss problems of a practical nature connected with the welfare of the Arts, Fine and Applied. At the present time, it was pointed out in the original prospectus of the association, many questions connected with Art and Industry stand in pressing need of discussion. Owing to the greater use of machinery, rendering less immediate the contact of the artisan with the object of manufacture, many old traditions of design are rendered obsolete. Questions, too, affecting the education of both artists and artisans, are involved in the industrial problems now before the world. In other directions, such as architecture, the need for skilled craftmen trained in the schools of painting, sculpture, and the decorative Arts is one of the practical necessities of the present day. The welfare and development of museums are matters also demanding attention. We would refer, also, to the intimate relations between Art and Science now existing, as evidence of the need for the earnest discussion of all such matters as come within the wide scope of an association for the advancement of industrial or fine Art.

Our space this month will not permit us to give more than a brief reference to some of the more important papers contribnted to the Congress at Liverpool. The sections met daily at the Walker Art Gallery and Rotunda Lecture Hall. In the evenings *soirées* and entertuinments were given in the Free Library buildings, the Royal Institution, St. George's Hall, and the Art Club. Mr. J. L. Bowes also held a reception at his residence in Liverpool. Speaking generally, the arrangements of the Congress were not carried out altogether with that regularity and exactitude which in all such enterprises is especially desirable. On more than one occasion it was found impossible to adhere to the daily published programmes, the order of proceedings, times of reading papers, and even the place of meeting being more than onee altered withont previous notice. No doubt allowance must be made for this being an initial meeting, and another year, probably, the working arrangements will be upon a stronger footing. The officers might, however, learn some valuable hints from the methods of management of the British Association, which usually give no such grounds of complaint as were unfortunately apparent at the Liverpool Art Congress.

Sectional Papers.

Mr. J. Towers read a paper on "The Encouragement of Local Art," urging that greater attention should be given to the formation and maintenance of local schools of Art and local artists. Mr. Alma Tadema traced the progress of Art from earliest times to the most modern branch of landscape painting, "depicting the passion and loveliness of nature." In an address on the "Encouragement of a Taste for Beauty," Mr. Alfred Gilbert, A.R.A., regretted the simply practical utilitarianism of the present day, a subject which was also touched upon by Professor Aitchison, who referred to the need for artistic architecture in our towns. Sculpture as an Art received attention at the hands of Mr. E. Onslow Ford, Mr. John Brett, and others.

One of the most scientific papers read at the Congress was that by Mr. G. H. Morton, Jun., on "The Agreement of Colour Theories with Actual Practice," which embraced, amongst some sound technical advice for the art decorator, an exposition of the combination and effect of primary and secondary colours and pigments. Industrial Art was a foremost topic of discussion, and the different branches of handicrafts, art metal work, &c., were treated of by Sir Philip Magnus, Professor Hele Shaw, Messrs. G. H. Garraway, H. B. Bare, and P. H. Rathbone. Mr. H. H. Statham, F.R.I.B.A., gave a popular lecture to working men on "Architecture."

Perhaps the department which gave promise of the most satisfactory results was that devoted to the interests of museums; and it was in this section that some of the most interesting discussions took place. Mr. Lionel Cust referred to what he called the inner life of museums, and made some suggestions for an ideal museum system in England, which included a Government department of Art education; every institution under the management of one man recognised as an authority on his special subject; the deposition of local collections in

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provincial towns and objects of national interest in the British Museum; the museums to be opened on Sundays, and special lectures given therein, with special reference to the wants of the working classes. Mr. T. C. Horsfall advocated the supplying of small Art collections to elementary schools. Mr. G. Simonds complained that museums did not reach the labouring classes. It was in vain to open them freely if they did not open them on Sundays. An admirable account of the Birmingham Museum and Art Gallery was given by the director, Mr. Whitworth Wallis. He said that the Birmingham collection was not merely a picture show, but a museum of industrial and decorative Art, the objects in which had a direct bearing upon the industries of the town. He pointed out the necessity for having cheap catalogues and penny handbooks for the various divisions, and considered that all objects should be labelled and fully described in language not too abstruse. In Birmingham, Sunday opening had been more generally adopted than in any other provincial town. In 1886 the average Sunday attendance was 1,906, and in 1888 it reached 2,346, the museum being only open from 2 to 5 p.m. This gave a Sunday attendance of 120,000 per annum. Despite the enormous attendance, there had been no difficulty in keeping order, nor had a single object been injured. In a paper which followed, Mr. J. Pyke Thompson, of Cardiff, urged with some very strong arguments the necessity for opening such institutions on Sundays, and these two papers gave rise to a lengthy discussion. During its course Mr. R. McMillan (secretary to the Liverpool Sunday Society), in a vigorous speech, combated the notion that the Society wished to increase Sunday labour or to open theatres and places of amusement on the "day of rest," which the working men and others desired to employ in a rational and intellectual manner, and to have the opportunity of studying their own collections on their only day of real mental rest, freed from the toils of labour.

At a general meeting of the members, held before the close of the Congress, Mr. Philip Rathbone proposed the appointment of a small committee to report upon Art schools, their organisation and methods of instruction, in England and abroad. It was decided to hold the second Congress next year at Edinburgh, under the presidency of Sir William Fettes Douglas (president of the Royal Scottish Academy).

The Anatomy of the Grebe.

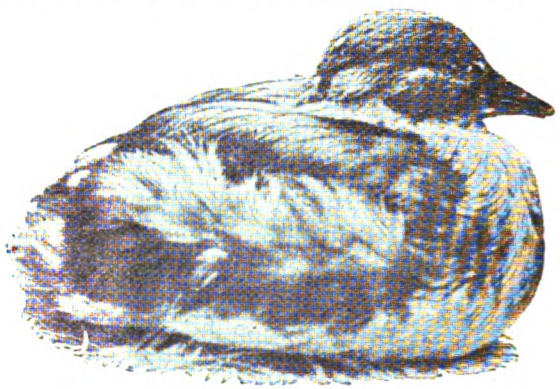
(Podiceps minor.)

By R. Newstead.

In December, 1887, I purchased for the Museum of the Chester Society of Natural Science a live grebe *(Podiceps minor)*. The bird had been slightly wounded by a shot through the cheeks near the base of the lower mandible. It seemed very lively, and was put into a room for further inspection, as I thought possibly something interesting might be learned from a bird which one so rarely has a chance of obtaining alive. On examining the bird about an hour after I found it in a corner of the room, where it had assumed a position more resembling a ball of feathers than anything else. The feet were quite hidden in the feathers, not a portion of them being visible until the bird got up to walk, and then I distinctly saw them come from alongside the wings. As this was the work of a moment I could not satisfy myself as to their true position in the feathers.

The bird now became very excited and ran about the room in an awkward manner, swinging the head from side to side at each step, and as soon as it ceased to walk it would directly rest on the breast--not entirely on the *metatarsi*, as is generally represented in books and stuffed specimens. It seemed impossible for it to remain in an erect position except when walking. The bird soon became tired and tried to hide away, so it was put into a box and left all night. The following day it seemed very much exhausted, and towards evening I was able to examine it carefully without disturbing it. The exact position of the feet was then easy to find. They were resting on the marginal feathers of the breast and belly (or vent), and laid close alongside the wings, the *metatarsus* crossing the *tibia* in an extraordinary manner, remaining in this position for several hours.

As I had a dead specimen of *Podiceps minor* waiting to be stuffed, I set to work at once and preserved it in the sleeping or resting position, the stuffed specimen being placed alongide the living one from time to time, so that the natural position should be perfectly preserved.



Grebe *(P. minor.)*

The accompanying illustration is from a photograph of this specimen, now in the Grosvenor Museum, Chester, which shows the exact position of *Podiceps minor* at rest, with the feet completely covered by the marginal feathers of the breast and vent.

On working out the anatomy of *Podiceps minor* I find there are two very interesting points. First, the *fibula* is not fused to the *tibia*, but is connected all along it with a very strong ligament, so that by taking hold of the foot the *tibia* can be made to rotate. The second point is a perforated and grooved bone at the back of the *metatarsus*, which has three perforations and carries eight tendons. On dissecting another species of grebe (*P. griseagena*, Bodd) I found the anatomy just the same as in *P. minor*. Several works on the anatomy of birds have been consulted, but no trace of the above facts could be found, so there is little doubt but that the curious position of the feet when the bird is at rest, and the hinged *fibulæ*, are peculiarities entirely confined to the grebes.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between November 16th and December 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S., F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	Highest (December 15th)	30·49	Inches
,, ,,	Lowest (November 27th)	28·86	,,
,, ,,	Mean	29·884	,,
,, ,,	,, for 21 years November	29·874	,,
,, ,,	,, ,, December	29·863	,,
Temperature	Highest (November 25th)	58·1	Deg. F.
,,	Lowest (December 13th)	28·4	,,
,,	Mean	45·6	,,
,,	,, for 21 years November	43·1	,,
,,	,, ,, December	39·7	,,
,,	of Evaporation	43·1	,,
,,	,, ,, for 21 years November	41·1	,,
,,	,, ,, ,, December	38·0	,,
(*b*) Rainfall	Amount	2·223	Inches
,, ,,	,, Mean for 21 years November	2·748	,,
,, ,,	,, ,, ,, December	2·733	,,
,,	Number of Days on which Rain fell	20	
,,	Greatest fall in 24 Hours (November 17th)	0·370	Inches

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Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	8·1 Inches.
,,	,, ,, for 21 years November	6·6
,,	,, ,, ,, December	6·9
(c) Wind	Velocity Greatest (November 20th)	71 Miles.
,,	,, Least (December 14th)	1 ,,
,,	,, Mean Hourly	23·6 ,,
,,	Greatest Pressure on Square Foot (Nov. 20, 1·5 p.m.)	23·5 Pounds.
,,	Direction at time of Greatest Pressure	W

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
3	55	180	72	159	189	55	7	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

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Bolton.

With the exception of the 28th November the weather from the 15th to the end of the month was warm, for the most part wet, and strong westerly winds prevailed to the 26th. On the 16th and 20th moderate gales blew, accompanied on the 20th by thunder and lightning and hail. Thunder and lightning also occurred on the 27th. In consequence of the prevailing strong wind the 28th was the only foggy day.

The mean barometrical pressure during the week ending November 21st was 29·82″, about the average; corrected mean temperature 47·44°; duration of bright sunshine 3 hours 36 minutes; relative humidity 86%; rain fell on every day to the total of 1·541 in. The force and westerly direction of the wind caused an unusual amount of ozone to be registered. From the 22nd to the 30th there was a range of 0·831 in. in the pressure, with a mean of 29·599″; mean temperature 45·07°; sunshine 2 hours 25 minutes; humidity 92%; rain fell on five days to a depth of 1·777 in.; wind westerly to the 27th, afterwards easterly.

The chief features of November as a whole were excess of rainfall, wind, temperature, humidity, ozone, and the slight amount of sunshine. Rain fell on 21 days, hail on 2, more or less sunshine on 7, fog 2, gales 3. The means or totals are:—Barometer 29·725 in.; mean temperature 44·93° (7·26° higher than November, 1887); relative humidity 88·3%; rainfall 6·116 in. (5·162 in. more than 1887); sunshine 12 hours 2 minutes, scarcely 5% of possible amount.

The first week of December was remarkably warm and calm, and daisies might be gathered in the Park with the ligulate petals as fully expanded as in June. The barometric pressure steadily increased during the week, with a mean of 29·899 in.; the mean temperature 47·98; only 41 minutes' sunshine; 89% humidity; four days' rain gave 0·658 in.; fog on the 1st. During the second week the pressure continued to increase, giving a mean of 30·251 in.; with the exception of the 8th the mean temperature ranged low, only 37·39°; one day's sunshine gave 3 hours 44 minutes; two days' rain 0·097 in.: humidity 88%. Hoar frost on the 9th, 10th, 11th, and 14th, and fog on the 10th.

W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, December 18, 1888.

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The Weather, November 16 to December 15, 1888.

On the 16th of November pressure varied greatly over our islands, being as low as 29·0 in. in the North of Scotland, and up to 30·10 in. in the South of England, and it remained much the same on the 17th, the isobars being close and running from West to East. An improvement set in on the 18th, and the barometer rose to 29·60 in. in the North and remained at 30·10 in the South; but it fell low again in the North on the 19th and 20th, but increased very decidedly on the 21st, when it varied between 29·60 in. in the North and 30·30 in. in the South. On the 22nd it fell again quickly to 29·20 in. in the North and was 30·20 in. in the South, and there was scarcely any change on the 23rd and 24th, but a further fall on the 25th. On the 26th there was a recovery of pressure in the North, but a fall to 29·60 in. in the South. The depressions indicated above had chiefly affected the northern parts of the kingdom, but on the 27th a deep depression from the West caused pressure to give way generally, and the barometer only varied between 29·30 and 29·40 in. all over Britain on that and the following day, and was still lower on the 29th and 30th. On December 1st the barometer had risen to 29·70 in the South, but was down to 29·40 in. in the North-West. On the 2nd it improved slightly, but fell again to 29·20 in. in the North-West on the 3rd, to rise once more on the 4th, falling in the North again on the 5th, and rising all over the kingdom on the 6th. The rise continued in the North on the 7th, but the barometer fell in the South, and on the 8th there was a general recovery of pressure, which ranged from 29·80 in the North to 30·10 in the South. On the 9th it was above 30·0 in. all over the country and remained high till the 13th, when another depression appeared in the West, but not of any great depth, and on the 14th it had filled up and pressure was again above 30·0 in., and rose as high as 30·40 in. on the 15th. The series of depressions in the North and West during the latter half of November and the first week of December, and the great variation of pressure over the kingdom generally, produced strong winds and gales, especially in the North and West.

	TEMPERATURE.							RAINFALL.				
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	* Means for November. Daily Max.	Daily Min.	Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Nov.* Ins.
Sheffield ...	60°	16th	32°	1st	45°	—	—	6·29	25	1·18	12th	—
Spurn Head.	59°	16th	36°	21st	46°	—	—	1·84	23	0·33	27th	—
York	61°	16th	33°	28th	46°	48°	36°	3·48	23	0·79	12th	2·21
Barrow	56°	15th	33°	28th	46°	—	—	5·19	21	0·65	27th	—
Liverpool ...	60°	15th	35°	7th	47°	48°	39°	4·50	24	0·61	12th	2·87
Holyhead ...	56°	24th	36°	28th	48°	50°	43°	4·71	26	1·14	12th	3·71
Oxford	59°	16th	33°	28th	46°	49°	37°	4·37	22	0·83	2nd	2·30
London	60°	16th	32°	8th	48°	50°	38°	4·04	19	0·75	2nd	2·14

* The means of Temperature and Rainfall for November are for 15 years.

The rainfall was much above the average and temperature high, never falling below freezing point at any of the above places.

The weather on the 16th and 17th November was wet and squally, especially in the North, and foggy in the South-West. Temperature was high in most places. From November 18th to 24th the weather was stormy, temperature was high, and much rain fell in the North and West. There were thunderstorms in Derbyshire, Sheffield, and various other places in the North on the 20th, with soft hail and sleet. Rain fell on 7 days at Barrow, 6 at Sheffield, Holyhead, and York, 5 at Spurn and Liverpool, and only 2 at Oxford and London. During the week ending December 1st the weather continued in a rough, unsettled state, with considerable falls of rain in most places, and occasional thunder and lightning in the South. Temperature was high for the time of year over England, but cold in Scotland, with sharp frosts in the North, the maximum readings in most parts of Scotland being below 49° on November 28th. There was rain on 7 days at Holyhead, 6 at Sheffield, Spurn, Liverpool, London, and Oxford, 5 at York, and 3 at Barrow. During the week ending December 8th temperature was high the air humid and misty, and the wind was strong in the North and West. At the close of the week, however, there was a decided change, the wind fell light, temperature gave way, and the air became drier and frosty. There was rain on 5 days at Barrow, Holyhead, and London (but very light at the latter place), 4 days at Sheffield, York, and Liverpool, and 3 at Spurn and Oxford. From December 9th to the 15th the

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weather was cold and rather inclement, though the rainfall was not great. The wind was light, and there were thick fogs in many places. Temperature was below the average over England, and on the 10th the thermometer in the Midland Counties remained below freezing point all day. Rather more genial weather was experienced in Scotland. There was rain on 4 days at Holyhead, 3 at Liverpool, 2 at Barrow, and on 1 day only at Sheffield, Spurn, York, and London, and none at Oxford.

Sun Spots.

From November 15th to the 26th no observations were possible owing to the cloudy weather, and on the latter date the sun was spotless. On the 27th the weather was again cloudy, but on the 28th there was a group of spots near the sun's eastern limb, which were, however, only indistinctly seen owing to fog. November 29th and 30th were again cloudy. On December 1st there was a large pyramidal spot, divided in the centre, about one-third the distance from the sun's eastern limb, and following close to this was a group of three smaller spots. These underwent considerable change in the next few days, the two parts of the large spot having become united and smaller on the 4th. On the 6th the three smaller spots had disappeared, and the large one had diminished in size. On the 7th the spot had become still smaller and was near the western limb, and on the 10th the sun was free from spots and continued spotless till the 15th.

Astronomical Occurrences in January.

There will be a total eclipse of the sun on the 1st, invisible in England. There will be a partial eclipse of the moon on the morning of the 17th. The first contact with the penumbra occurs at 2-40 a.m. First contact with the shadow 3-59 a.m. Middle of the eclipse 5-30 a.m. Last contact with the shadow 7 a.m. Last contact with the penumbra 8-20 a.m. The moon will set at 8-10 a.m. Magnitude of the eclipse (moon's diameter = 1) 0·7. There are two new moons in January. It is new at 9-8 p.m. on the 1st, enters its first quarter at 41 minutes after midnight on the 8th, is full at 5·37 a.m. on the 17th, enters its last quarter at 3·57 p.m. on the 24th, and is new again at 9-10 a.m. on the 31st. Venns is an evening star, setting about 3½ hours after the sun, and may be seen in the S.S.W. after sunset, and at the beginning of the month Mars is visible as a dull red star near to Venus. These two planets are in conjunction on the 2nd. Saturn rises about 7 p.m. at the beginning of the month and at 5 p.m. at the end, being then on the meridian about midnight, so that it will be visible during most of the working hours of the night. It is situated in Leo, and well placed for observation. E. Howarth, F.R.A.S.

Weston Park Museum, Sheffield, December 20th, 1888.

Reviews.

Liverpool Biological Society. [Proceedings, vol. ii. Session 1887-8.]

The second session of this Society has been certainly successful, if a plenitude of matter brought before its members be a criterion of successful operations. The thick volume of 230 pages now issued contains fifteen papers and reports presented to the Society during a single session in the winter months and printed *in extenso*, in addition to the usual official matter. As an indication of its contents we give the titles of some of the more important contributions. Dr. W. A. Herdman gives a report on the foundation and first season's work of the Liverpool Marine Biological Station on Puffin Island, and also a note on the specific nomenclature of *salpa*. There is a long essay, entitled the "Geology of Puffin Island," by J. W. Gregory, F.G.S., which occupies no fewer than seventeen pages, describing a small island three-quarters of a mile long by a quarter broad, composed throughout of a single geological formation. This may be taken as evidence of the thoroughness of the author's work, but, as a matter of fact, the title is a misnomer. The amount of matter actually relating to Puffin Island could have been compressed with advantage into four or, at most, five pages. The remainder of the space deals with such "outside" questions as the marine origin of the Moel Tryfaen drifts, and a *résumé* of Ramsay's glacial theory as applied to North Wales. In this connection, too, the use of the phrase "geological jingoes" (p. 86) is not to be commended. The Report on the Polyzoa of Puffin Island, by Mr. J. Lomas, Assoc N.S.S., is drawn up within more concise limits, and, so far as it goes, is very complete and accurate. Mr. Isaac C. Thompson, F.L.S., contributes an interesting account of a visit to Madeira and the Canaries, together with two reports on the *Copepoda*, a branch of research to which he has given special and minute attention. Dr. J. W. Ellis, F.E.S., describes an actiniarian new to Liverpool Bay, and a lengthy catalogue, carefully compiled, of the coleopterous fauna of the Liverpool district. There are also papers by Dr. Hannitsch, Mr. R. J. Harvey Gibson, Mr. Alfred O. Walker, and Miss Alice Heath. We have left until the last mention of the President's inaugural address, which stands at the head of the volume. Dr. Drysdale has produced a valuable historical summary of the theories regarding "Life," and its definition as affected by the protoplasmic theory. Many of his contentions are now so well recognised by biologists that further discussion of them is needless. On the other hand, several debateable points are raised. The necessity for rigidly restricting the meaning of the word "protoplasm" to the ideal living matter alone, not to be applied to the contents of cells, some of which are not living, is urged. Life is defined as "the interaction of protoplasm with the environment"—a species of definition which, though undoubtedly accurate, yet helps us no further in comprehending the mystery of the vital principle. The various papers now printed, however, are generally of a high order of excellence, and their production speaks well for the energy and working ability of the members. If the Biological Society makes in the future as much progress as it has already done in the first three years of its existence, it will undoubtedly take high rank amongst the learned societies of the United Kingdom.

Annual Report for 1887 of the Yorkshire Naturalists' Union.

In presenting their 26th annual report, the council state that the Union, which now consists of thirty-seven societies, has resulted in much good work being done towards the investigation of the fauna and flora and physical features of Yorkshire. Five meetings have been held during the year, as follow:—Saltburn, 30th May; Gormire Lake, 20th July; Sedbergh and Howgill Fells, 1st August; Welton Vale, 27th August; and Hatfield Chace, 21st September. The total aggregated membership of the affiliated societies now amounts to 2,109. Two parts of "Transactions" have been issued, containing papers on "Yorkshire Botany," a continuation of the Rev. W. C. Hey's list of Yorkshire beetles, and the first instalment of Mr. Baker's "North Yorkshire," illustrated by a remarkably fine and clear geological map of the North Riding. The "West Yorkshire Flora" has also been issued to the subscribers. During the year two committees for research have carried on successful operations, viz., the Yorkshire boulder committee (of which we gave some account in our last number), and the committee for investigating the marine zoology of the Yorkshire coast. The president of the Union for 1888 is Mr. Wilfred H. Hudleston, F.R.S.

Journal of the Liverpool Astronomical Society. November, 1888.

This is an excellent number of this useful journal, which appeals to all who are interested in the science of Astronomy. It contains the president's address, by Mr. T. Gwyn Elger; an important paper by Mr. Edward S. Holden, on "Physical Observations of Mars during the Opposition of 1888, at the Lick Observatory," illustrated with no fewer than twelve plates; besides articles on "Mr. Lockyer's Meteoric Theory," "Some Comets of the Last Century," and a continuation of the president's papers on the "Moon Surveyed in Common Telescopes." Under the new editorship of Mr. I. H. Isaacs, the appearance of the journal, both as regards printing and arrangement of matter, shows a great improvement upon past issues. In the editorial "Notes" we find an interesting reference to the original work of Mr. George Higgs (a member of the society) in photographing the solar spectrum, in which Mr. Higgs has attained some excellent results, surpassing in some respects the fine spectroscopic pictures of Professor Rowland.

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Primer of Micro-Petrology. By W. Mawer, F.G.S.
[London: John Marshall and Co.]

In this work, Mr. Mawer gives a short account of the chief facts which students of the subject so much need for their guidance on entering upon their investigations. The use of the microscope in Geology has latterly risen to position of great importance; grave issues are now decided by an appeal to the microscopic section of a given rock. Opening with a brief chapter on rock-structure, the author touches upon some of the principal mineral constituents of rock masses as seen under the lens of the microscope, and adds some useful illustrations of each specimen from his own pen-and-ink sketches. We can heartily recommend this book, which, although it is so much condensed, will form an excellent elementary guide to the subject of which it treats.

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Proceedings of the Society of Amateur Geologists.
[London, 1888.]

Although there are two other institutions for the social study of geological science in London, it would appear that there is room for a third, judging from the number of papers read and printed in the "Proceedings" of the Society of Amateur Geologists. We notice, however, that the majority of these papers are contributed by those who are fellows of the senior Geological Society. If the new society wishes to do really good and independent work, it should endeavour to bring forward the work of its own members, who have more claim to be regarded as amateurs than those who are already fellows of other learned societies, and so strike out a distinct line of its own. The president's address, by Mr. William Semmons, F.M.S. (who, however, is hardly an "amateur"), deals with Cornish minerals, a subject with which no one is more thoroughly familiar. Mr. Semmons takes rank among the first mineralogists in the country.

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Publications Received.

"Chester Societies" is a useful monthly summary of intelligence concerning the work of the different societies of the "rare old city of Chester." Music, Art, and Science are all represented in its pages. Mr. Wm. Shone, F.G.S., contributes to the November issue some further notes on the great Cae Gwyn Cave controversy, which has been raging so strongly amongst geologists with respect to the age of certain deposits, supposed by one school of thought to be pre-glacial.

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Life-Lore, a magazine devoted more especially to biology, appeals to all who take interest in the study of Natural History. It is well printed, and contains some excellent illustrations. The articles, too, are good, and there are many that are excellently designed to assist elementary and even juvenile students.

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Annual Reports.—We have received the reports of the Manchester Geological Society, 1887-8; Liverpool Geological Association, 1887-8; Yorkshire Boulder Committee (second year's work), by Mr. S. A. Adamson: *Transactions* of the Leeds Geological Association, Part iii., 1886-7; *Proceedings* of the Yorkshire Geological and Polytechnic Society, 1887; &c., &c.

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New and Forthcoming Works on Science.

Messrs. Longmans & Co. announce the early publication of the following scientific works, viz.:—*Force and Energy*, by Grant Allen; *Physical Realism*, by Thomas Case, M.A.; *The Illustrated Optical Manual*, by Surgeon-General Sir T. Longmore, C.B., F.R.C.S.; *Elementary Theory of the Tides*, by T. K. Abbott; *Animal Physiology*, by W. S. Furneaux.

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A new venture in monthly magazine literature, entitled *The Library*, is announced to be launched by Mr. Elliott Stock, the well-known publisher, of London, the first number of which will doubtless have appeared by the time this notice is in print. It will take the place of the defunct *Library Chronicle* as the official organ of the Library Association. The editor is Mr. J. Y. W. Macalister, one of the honorary secretaries for the Library Association, and formerly of the Liverpool Lyceum Library. Among the contributors are Dr. Garnett (of the British Museum), Andrew Lang (president of the Folk-Lore Society), William Blades, Sidney Colom, Walter Besant, Chancellor Christie, C. W. Sutton (Manchester), P. Cowell, T. Formby (Liverpool), and E. C. Thomas (late editor of the *Library Chronicle*.)

Societies.

Selborne Society.—We are pleased to see that the Selborne Society is developing one of its objects, viz., the promotion of the study of natural history. We gather from a contemporary that the Bath branch of this Society is moving in this direction by the establishment of a library, and it is stated that "the committee, having voted £10 for the purpose, entrusted Mr. W. G. Wheatcroft (the hon. sec.), M. J. W. Morris, and Mr. Norman with the selection of the books that are to form the nucleus of the library. Bearing in mind the objects of the Society, we think they have made a very good choice. The volumes acquired include such standard works as Morris's British Birds and Butterflies; Wooston's Alpine Plants, a book that has special interest for us since many of the species are naturalised in our Botanic Garden; Stark's British Mosses; Dr. Cooke's Microscopic and Larger Fungi; Knapp's Journal of a Naturalist (the Gloucestershire Selborne); Kirby's Entomology, and Lobley's Geology for All. Besides these and other works of a kindred character there are two of Sir John Lubbock's books on flowers and insects, two of Miss Ormerod's on insects and insect life, Sowerby's popular history of the Aquarium, the Young Collector's Manual (several volumes), Nicholson's Manual of Zoology, Gosse on the Ocean, Johns' Flowers of the Field, Drury's Ferns, &c. It is intended to make the library available for reference, as well as a circulating medium of imparting knowledge in the various departments of natural history." We also hear that the Richmond branch, of which H.R.H. the Duke of Cambridge is president, is offering prizes for papers on natural history subjects, and supplying books on natural history to the Richmond Free Library. We are convinced that, if people will only learn the ways of birds and beasts, and get to know more about plants and their histories, they will do their utmost to carry out the other objects of the Society—the preservation of the fauna and flora of this country.

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Chester Society of Natural Science.—On 22nd November, Mr. H. M. J. Underhill (secretary of the Oxford Natural History Society) gave a lecture on "The Microscopic Life of our Ponds and Streams," a title recalling somewhat one of the popular lectures of the Rev. J. G. Wood. The lecturer referred to the early controversies as to whether certain microscopic organisms were plants or animals, and had thrown upon the screen a large number of very beautiful views of polyzoa, explaining the action of their food-catching apparatus—a crown of tentacles each one fringed with fine hairs These hairs move ceaselessly with a regular rythmical wave-like motion. This motion produces currents in the water, and the currents bring food to the mouth of the animal. These polyzoa possess also a mouth, throat, stomach and intestines, muscles, nerves, and a circulatory system. From this point the lecturer proceeded to simpler and simpler organisms, through the tube-building Rotifers and the Hydræ and the fresh sponges to the vorticellidæ or vortex makers, whose food-catching apparatus was of the same class as that of the polyzoa and rotifers, namely, a set of hairs or cilia producing currents in the water. Next came a family of Infusoria, known as the silent bells, whose food-catching organs were simply a funnel and one long hair or lash which, moving to and fro, created currents in the water, and caused the food to fall into the funnel, which surrounded the lash for one-third of the ils length. The animal had no mouth nor throat, but at the part at the base of the funnel the food was taken in through the substance of the body. The lecture was illustrated by slides painted from life and by living specimens. The sectional meetings of this Society included a course of elementary lectures on photography, which promise to be especially useful to the members. Mr. Fawcus described the manipulation of photographic apparatus, and Mr. E. W. Cowan subsequently gave a demonstration of the development of negatives. Mr. W.

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Shone, F.G,S., gave an admirable paper on Charles Kingsley's love of nature, and its influence upon his life. The Natural Philosophy Section discussed some peculiarities of vision, as illustrated by a series of excellent models and diagrams made by the chairman, Mr. G. Watmough Webster, F.C.S. Mr. Geo. E. Thompson gave, on 12th December, a "Lantern Demonstration" of the "Waterways of Holland," illustrative of a tour taken by him last July. The first meeting of the newly added Section of "Applied Science" was attended by a large audience, who fully recognised the importance of the subject of "Electric Lighting," brought before them in a very practical manner by Mr. Phillips, A.M.I.C.E., who traced briefly the growth and development of this method of lighting, showing its superiority from an artistic, hygienic and even an economic point of view to other methods. A member of the Chester Society, Mr. F. Evans, has been awarded a silver medal for his photographs of Moreton Old Hall, exhibited at a recent meeting of the Birkenhead Photographic Society.

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Manchester Field Naturalists' Society.—The autumn *soirée* was held on 28th November, in Memorial Hall, Albert Square. The President (Mr. Leo H. Grindon) sent a series of illustrations, showing the life history of our large forest trees. A fine collection of hardy garden plants and flowers, fresh from Llandudno, graced the room. Mr. Robert Holland (of Frodsham), in the course of the evening, gave a suggestive and practical address on "Trees in Towns, and Suburban Gardening near Large Cities.", in the course of which he referred to the use of vegetation in the economy of nature, and the general destruction that was taking place amongst plants and vegetation It was, he said, a great mistake to denude a country of its timber. He was afraid we should never again have the fine vegetation in our country which existed some centuries ago, as the air of England had been permanently vitiated by poisonous gases and coal smoke. Trees could not be grown anywhere near our large towns such as those which thrived in former times, and he attributed the great amount of the deterioration which had taken place in our vegetation to the effect of common coal smoke. The trees were not able to carry on their functions for a sufficient time each year, and, therefore, their growth was very small, stunted, and the whole plant became sickly.

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Manx Geological Society.—We have to chronicle the establishment of a new Geological Society at Douglas. The Isle of Man offers a very wide field for geological exploration, more especially as it has not yet been officially surveyed, and we cordially wish the members of the new society success in their work. At an inaugural meeting held at Douglas, on 5th December, the draft rules were drawn up and considered. It is intended to form an insular museum of Manx geology, the collections to be placed temporarily in the Free Library at Douglas. During the winter session a course of lectures is to be given by Dr. Haviland, the president-elect, who purposes to treat of the principles of the science of Geology as illustrated by Manx rocks and scenery.

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Yorkshire Philosophical Society.—This Society has entered upon a new lease of vigour. By a new rule abolishing the entrance fee and reviving the old system of lectures, nearly 100 new members have been added to the roll. In addition to the monthly meetings, special lectures are given in the galleries of the fine Museum at York. A Photographic Section has recently been formed, which already numbers over 40 members. Its object is to encourage and assist the study of photography, both in its scientific and artistic aspects, and to enable members by means of meetings, mutual discussions, exhibitions of negatives and by field-excursions, to work out new processes and to improve their skill. Special attention is given in these excursions to such practical matters as the manipulation of the camera, the selection of the point of view, and duration of the exposures. The Section also aims at gathering, by the work of its members, a series of views to illustrate the topography of Yorkshire, with special reference to its artistic, architectural, and geological features. A dark room has been fitted up in the Museum, and apparatus for enlarging by artificial light is being provided. The Society also possesses an observatory, fully equipped with an equatorially-mounted telescope, transit instrument, 4¼ inch equatorial, with micrometer and clock movement, &c. Amongst the names of lecturers announced in the programme of the session terminating at Easter, 1889, we note the following:—Professor Flower, C.B., who lectured on "The Pigmy Races of Men;" Benjamin Baker, F.R.S., Joint-Engineer of the Forth Bridge; Dr. J. E. Taylor, Editor of *Science Gossip*, who describes his "Holiday of a Naturalist in Australia;" Professor G. F. Browne, B.D., of Cambridge, who takes for his subject - "Subterranean Ice;" Dr. Tempest Anderson, B.Sc., with his excellent photographs of the volcanoes of Sicily and the Lipari Islands, and Professor L. C. Miall, of Yorkshire College, Leeds, who is to give a lecture on "The Life of a Yorkshire Stream." We are pleased to note the very active spirit displayed by this Society. Its printed prospectuses and announcements are themselves models of what such publications should be, the circulars of many societies in the country being greatly deficient in information as to their proceedings and welfare.

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Liverpool Microscopical Society.—The eighth meeting of the present session was held at the Royal Institution, on December 7th, the president, Mr. A. Norman Tate, F.I.C., F.R.M.S., in the chair. An interesting paper, by Professor A. Barron, M.B., entitled "Some Remarks on the Diseases Associated with the Parasite, Bilharzia Haematobia," was read by Dr. Larkin, in which was described the life history of this peculiar parasite, which is found in the mature condition in the blood vessels of man, apes, &c., and in its embryonic state in the waters of rivers and canals of Egypt and other African countries. The chief interest attending it is that it produces many diseases peculiar to these countries, from which our troops in Egypt have suffered considerably. These vary according to the part of the body infested by the parasite; usually it is in the kidneys or bladder, producing hematuria in the lower bowel, causing dysentery, and in the lungs a disease stimulating consumption. Professor Barron has recently discovered that persons who for many years have been troubled with the above parasite frequently develop cancer, and he is of opinion that it is probable that the cancer has been produced by the irritation of its continued presence.

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Historic Society of Lancashire and Cheshire.—The fourth meeting of the forty-first session was held at the Royal Institution, Liverpool, on 29th November. A paper was read on "Recent Finds on the Cheshire (Meols) Shore" by Mr. Charles Potter, who exhibited a large number of objects of interest, nearly all found by himself upon the shore during the last thirty years, among them being worked flints, fragments of the antlers of red deer, which had been used as picks or hammers, and primitive pottery. "These," said Mr. Potter, "belong to the Neolithic period, and since the stratum, or surface soil, from which they have been obtained is unbroken between the Mersey and the Dee, and the underlying strata are undisturbed, it is difficult to understand on what grounds those who hold the levels of the land hereabouts have been materially changed base their opinions." In a word, Mr. Potter does not believe that the mouth of the Mersey was ever at Leasowe.

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Liverpool Science Club.—Herr Moritz Uhland lectured in the Museum-buildings, William Brown-street, on "Volapuk," the new universal language. The lecturer showed the length of time men had striven for some international means of communication for the

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statesman, the traveller, and the trader. In 1868 the Rev. Father Johann Martin Schleyer, of Baden, Germany, invented a complete language, which would serve the whole world. The first work on the subject was issued in 1880, and now, according to the Volapuk journals, two millions of people are studying the new language, and it is a compulsory subject in 257 schools throughout Europe. The long-felt need for some universal means of communication, and the fact that no existing language could possibly fill the international requirements, are the chief reasons for this sudden and growing popularity. The lecturer stated that it takes an English child 2,500 hours to learn its orthography, while the same child could acquire the spelling of Volapuk in one hundred hours, and that an intelligent adult could learn it in fifteen minutes. Some of the greatest living philologists had spoken well of this new artificial language, which was not intended to supersede the mother tongue, but simply to be learned in addition.

LANCASHIRE AND CHESHIRE ENTOMOLOGICAL SOCIETY.—At the last monthly meeting of this Society Mr. W. E. Sharp read a most interesting paper entitled "The Classification of the Coleoptera: Some Notes on its History." The president (Mr. S. J. Capper, F.L.S.) read a summary of Dr. Ellis's "Lepidopterous Fauna of Lancashire and Cheshire," from which it appears that 68 per cent of the recorded British species of this order have occurred in the above counties.

YORKSHIRE NATURALISTS' UNION: THE GEOLOGICAL SECTION.—The Geological Section of the Yorkshire Naturalists' Union was presided over, at the recent annual meeting held at Sheffield, by the Rev. E M. Cole, M S.A. Mr. S. A. Adamson, F.G.S., gave a brief account of the work done during the past year. The duty of this section consists in carrying out as completely as possible the geological part of the work in the excursions arranged by the executive, work of a special character, although allied with the science of geology, being undertaken by special committees appointed for that definite purpose. The first excursion was to Leyburn, where, in that classic dale, that enthusiastic field-worker, Mr. Horne, F.G.S., conducted a large party. The second excursion, having its rendezvous at Uppermill, included a wide range on the west of the Yorkshire Pennines. To the able and experienced leaders upon that occasion (Messrs. W. Watts, F.G.S., and J. Nield, of Oldham) the geologists of the Union feel under special obligation. The third excursion was arranged to the Peak district, but, unfortunately, drenching rains and dense fogs prevailed all day, and hence nothing more than the Crag Hall Quarry could be visited, leaving the Peak itself for the delights of anticipation. The fourth meeting at Market Weighton was conducted by the Rev. E. Maule Cole, M.A. Beds of the Lower Lias (zone of Ammonites angulatus) and of the Lower Chalk were first carefully examined, passing on then to view a cutting being made for the new railway intended to connect Market Weighton with Driffield. Thus the members of this Section who have duly attended upon the appointed field-days have been rewarded by fine opportunities of studying in the field itself the formations alluded to, the Cretaceous, the Oolite, and the Lias in part, and the Millstone Grit series, and the Yoredale Rocks almost in their entirety. The retiring officers of the Section, the Rev E. Maule Cole, M.A., of Wetwang, president, and Messrs S. A. Adamson, F.G.S. (Leeds), and S. Chadwick (Malton), secretaries, were re-elected.

ISLE OF MAN NATURAL HISTORY AND ANTIQUARIAN SOCIETY.—The monthly meeting was held at Ramsey, on 1st Nov. The question of the publication of a quarterly journal was considered. Miss Crellin contributed an account of the opening of a large burial mound at Kirk Michael, containing urns and a flint implement. It was announced by Dr. Haviland that he had succeeded in arranging with the Director General of the Geological Survey for the survey of the island to be carried out in the course of next year. A report was read by Mr. George Swainson on the results of the excursion of the Wesley Scientific Society to Dalby on August last, giving details of the biological specimens found on the occasion of the visit.

THE GEOLOGICAL SOCIETY OF LONDON.—At the meeting held on 7th Nov, an elaborate paper on the "Permian Rocks of the Leicestershire Coal Field" was read by Mr. Horace T. Brown, F.G.S., upon which afterwards arose an interesting discussion. The author, in his paper, contended that certain rocks belonging to the Carboniferous and the Trias have been erroneously mapped as Permian by the Survey, an example of which occurs in the patch at Knowle Hills, really a wedge-shaped piece of Lower Keuper, let down by a "trough" fault. He then pointed out the true lithological characters of the Permians of Leicestershire; consisting of red and variegated marls, bands of breccia and fine-grained yellowish sandstone, The breccia fragments are imbedded in a bluish-grey matrix, united together by carbonates of lime and magnesia, with some hydrated ferrous oxide, which on exposure becomes oxidized. The author concluded that these rocks belong to the same area of deposition as those of Warwickshire and South Staffordshire, but that the deposit on the eastern side of the Pennine chain were dissimilar from those on the western. There were proofs of the existence of a land-barrier, owing to the uprising of the Carboniferous strata between the district around Nottingham and the Leicestershire coal field. The probable course of the old coast-line of the western Permian lake was traced. During the progress of the author's investigations he had made extensive use of the hand-borer, an instrument which (it was pointed out in the discussion by Mr. Topley) was also largely employed by the officers of the Geological Survey, who obtained their pattern from a borer in use on the survey of Belgium. A paper was also contributed by Mr. J. B. Tyrrell, F.G.S. (Field Geologist of the Canadian Survey) on the "Superficial Geology of the Central Plateau of North-western Canada." At a meeting on November 21st, Mr. W. Whittaker, F.R.S, exhibited a series of specimens from the deep boring at Streatham, which passed through 10 feet of gravel, 153 feet London clay, 88 feet Lower Tertiaries, 623 feet chalk, 28½ feet upper greensand, 188½ feet gault, 38½ feet of jurassic rocks. At a depth of 1,120 feet the tools entered a set of beds of much the same character as should be found beneath jurassic beds at Richmond, consisting of fine-grained sandstones of reddish tint, with thin veins of calcite. The age of these beds may range from Trias to Devonian. The question of their age is of some importance, as upon it depends the possibility of the presence of coal measures in the district. Papers were also read on "The Remains of Five Genera of Mesozoic Reptiles," by R. Lydekka. F.G.S.; "Notes on the Radiolaria of the London Clay," by W. H. Shrubsole, F.G.S., and on "A New Species of *Clupea* (*C. vectensis*) from Oligocene strata in the Isle of Wight," by E. T. Newton.

CHESTER ARCHÆOLOGICAL AND HISTORIC SOCIETY.—At the November meeting of this society, Mr. G. W. Shrubsole (hon. curator called attention to the discovery of a Roman centurial stone, found in digging the foundations for some new premises in Eastgate Street. The stone bore the following inscription:

CHOR III
)TER ROM

which, expanded and translated, indicated the "Century of Terentius Romanus of the Third Cohort of the 20th Legion." The use and purpose of these stones when first discovered appeared somewhat in doubt. Antiquaries were divided in opinion. The discovery, however, of several of them *in situ* along the face of the great wall of Hadrian, and also at the larger Roman castra, had brought

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out more clearly their intended purpose, which was to indicate the location of a body of Roman soldiers, namely, a centuria, composed of 100 men, the name of whose centurion or commander is recorded on the stone. These stones were not only used to mark the site of a camp, but also to record certain work done by a particular centuria, such as building a wall or turret. These relics are to the archæologist what fossils are to the geologist, and help us to retrace the historic through long-forgotten steps of ancient Roman legions.

LIVERPOOL GEOLOGICAL ASSOCIATION.—On the evening of Monday, December 3rd, the usual monthly meeting of this Association took the form of a *conversazione*, at which various objects of geological interest were exhibited by members and friends. The President, Mr. A. Norman Tate, F.I.C., F.G.S., in taking the chair expressed the pleasure it gave him to see such a varied collection of exhibits, indicating the numerous directions in which geological enquiry was proceeding. They had before them, for instance, a series of instruments used in mineralogical research, the construction of Mr. D. Clague, and an examination of these would show that, although mineralogy was such an old science, still it had been found possible to improve on some of the old methods of work, such as the measurement of crystal angles. The wooden models which had been so carefully constructed by Mr. H. C. Beasley, exhibited in a ready manner the results of the minor movements undergone by our local sandstones. In the photographs placed before them they would also see that there might be something more than a picture to look at; that it might be possible so to group them as to illustrate an idea. Such illustration had been effected where the Tors of Dartmoor and the peaks of Arran had been placed side by side, to show the outlines assumed by weathering granite masses; and also in the New Zealand photographs contributed by their honorary member, Professor Judd, where the phenomena succeeding a volcanic eruption were displayed. Further references dealt with the value of such collections of rock specimens as those shown by Dr. Ricketts, F.G.S., where it was sought by illustration to trace the weathered glacial boulders of this district to their sources; by Mr. W. H. Miles, where probable evidence of plant life was shown in the new red sandstone; and by Mr. Hornell, where the materials gathered on a neighbouring sea-shore during a holiday trip had been brought together to excite enquiry as to the structure indicated by their accompanying drawings. At a later period of the evening, the President having another engagement to fulfil, Mr. H. C. Bramall, ex-President of the Association, took the chair, and Mr. Joseph Lomas gave a short address descriptive of the Tarawera (New Zealand) photographs already referred to, and the geological features of this volcanic district.

THE WELLS NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.—A society bearing this name was established on November 29, at Wells, Somerset, with Lord Hervey, Bishop of the diocese, as first president, Dr. Livett, vice-president, Mr W. Hippisley, hon secretary, and a committee consisting of Miss Livett, Miss Molyneux, the Hon. F. Sugden, Mr. Abram, Canon Chard, and Dr. Fairbanks. The first meeting of the society was held on December 13th, in the Cathedral Chapter Grammar School. The Lord Bishop presided, and delivered an interesting address, in the course of which he strongly recommended the members to observe for themselves, and keep a careful and accurate record of their observations; to maintain the habit when walking abroad of watching the natural objects they saw around them; and so make every walk in the fields, or a stroll in their own gardens, doubly enjoyable, while administering largely to the usefulness and happiness of their lives. Dr. Livett afterwards delivered an interesting lecture on "Entomology."

EALING MICROSCOPICAL AND NATURAL HISTORY SOCIETY.—On the 24th November a lecture was delivered by Dr. W. B. Richardson, F.R.S., on "Antony Van Leeuwenhoeck, the Father of the Science of Microscopy," which was of a specially interesting character. The lecturer opened by saying that amongst men of mark there are those who carry the torches and those who carry the lanterns. The torch-bearers are the men who, for the moment, are most known and followed, but they, generally, let their torches go out even before they die, while the lantern-bearers carry the light to the end, and leave it aflame for their successors to spread the light further and further amongst men. Van Leeuwenhoeck was one of the lantern-bearers, and the light he struck was not extinguished even to this day. Born at Delft, in 1632, he became a clothier at Amsterdam at the age of 16, afterwards he married, and returned to the quaint little Dutch town, his native place, where he ended his days in 1723. He has made himself immortal by his great and original discoveries with the microscope, gaining high distinctions not only at the Academy of Sciences of France, but also the Fellowship of our own Royal Society. The most eminent men of his age, including a no less important political personage then Peter the Great, were his visitors. By the instruments he constructed (twenty-six of which—all now lost—he left to our Royal Society) he was enabled to investigate the anatomy of flies, the minute structure of woods, especially of oak, the structure of the muscles of animals, and of the heart of the sheep and the duck; the eye-ball and the fine structure of the crystalline lens. His crowning triumph was the discovery of the capillary circulation of the blood, a part of the circulation left unsolved by Harvey. The author's own enthusiastic words were given descriptive of his delight when he first saw the blood coursing from the arteries and veins through its own minute tubes, and carrying its own little red globules in myriads, by which alone its course could be rendered visible. As a naturalist, Leeuwenhoeck's studies in plants, vegetables, and their products; on the natural ages of animals.—especially whales, some of which he believed might live a thousand years—his enquiries into various mechanical subjects; his ideas as to the formation of clouds, all reveal to us his real greatness of originality and industry. Various diagrams, views, portraits, and other illustrations were given to aid pictorially the lecturer's account of his subject.

LIVERPOOL AND DISTRICT SCIENCE AND ART TEACHERS' ASSOCIATION.—At a meeting of this Association, held at the School of Art, Mount Street, after the usual routine business, the president (Mr. W. Hewitt, B.Sc.) delivered an address, in which, after referring to the useful work that had been done by the association, he treated of the position of natural science in elementary education. He pointed out that the value of this subject was being slowly but surely recognised, every commission that had in recent years dealt with the subject of education having pronounced more emphatically in its favour. It was now generally recognised that the question resolves itself into providing for (1) a suitable preparatory course of training for the purpose of developing the mental and physical powers of the child; and (2) upon this foundation, where it is necessary or desirable, to superpose the special technical knowledge. As it was long ago pointed out very forcibly, "the mind is the most important instrument which the handicraftsman will ever be called upon to use, and therefore a technical education which teaches him to use a lathe or a loom before he had learned how to use his mind is no education at all." The recent Royal Commission pointed out that in too many cases the young people leaving our elementary schools are absolutely unfitted to profit by the opportunities for technical instructions already open to them, and added—"We have here an additional argument—if, indeed, any such were needed—for the more general introduction into our elementary schools

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of drawing, and of a sound, thorough, and practical instruction in elementary science, as regarded essentials of the usual school curriculum." Mr. Hewitt then described the provision in the present Education Code for the teaching of elementary science, or, rather, for the recognition by payment of grants for that subject. He pointed out that, in reality, the conditions were not so favourable as they appeared on paper; that, either by reason of the limitations and conditions placed upon managers and teachers in their choice of subjects, or the unsatisfactory nature, in many cases, of the method of examination, small encouragement was given to the introduction of such subjects into the schools. The subjects, if taught at all, should be taught in a proper and reasonable manner—taught, not with a view to immediate results, but for the purpose of promoting the formation of useful mental habits and modes of thought; taught as far as possible by contact with and experience of the actual facts and phenomena. It would probably be necessary to take some steps to secure a better organisation of our science and art classes, to provide for regular courses of study under more efficient conditions; and, as there were growing signs of an improved system of evening schools being established, where a bright, attractive, and stimulating course of instruction would be given, such technical and continuation classes might not inaptly take their place in many cases as part of the arrangements of such schools. Messrs. Sloane and Lloyd Barnes afterwards exhibited on the screen two instruments of their own construction, for the purpose of combining two rectangular vibrations to illustrate certain problems in acoustics. Mr. Wilding exhibited a number of slides illustrating the development of gothic architecture; and Mr. Read also showed some slides, drawn by himself, to illustrate lectures on geology, physiology, &c.

GEOLOGICAL SOCIETY OF GLASGOW.—The third meeting of the 31st session was held on Thursday evening, the 13th December, in the Society's Rooms, 207, Bath Street, Mr. Joseph Somerville, vice-president, in the chair. Messrs. Wm. Cullen and Duncan McIntyre were elected and several gentlemen were proposed, as ordinary members. The hon. secretary (Mr. J. B. Murdock) read, on behalf of Mr. Robert Craig (cor. mem.), Langside, Beith, an interesting paper entitled "Notes on the Fossiliferous Strata Exposed in the Gurdie Cutting of the Kilbirnie Branch of the Lanarkshire and Ayrshire Railway." In the course of his paper the author compared the successive beds found in this horizon with those formerly known in Kerrsland Glen, in the same neighbourhood, of which he had in a previous paper given a full account, and showed that though varying in thickness they were, as proved by the contained fossils, practically identical. In various instances the fossils were, however, larger and finer than similar species found in Kerrsland Glen. Mr. Craig called attention to the remarkable fact that in this locality about 60 feet in thickness of the limestones and shales which are present over the greater part of the Beith and Dalry district are wanting, whatever may be the explanation. Mr. James S. McLennan then read a descriptive paper "On the Geology of the Leighton Valley," in which he traced the occurrence of the rocks present from their lowest to their highest members, calling attention to the surface configuration of the whole district under review, and to the remaining traces of old human occupation still scattered over it. In connection with his remarks upon the latter subject Mr. McLennan said—"It is an interesting fact that from very early times these elevated masses of intrusive igneous rock have been selected as sites for strongholds, and that, in Scotland, at least, most of our great historic castles have been so situated. Edinburgh, Stirling, Dumbarton, and Dunbar all occupy the summits of commanding heights composed of volcanic rocks, around which the din of battle and the strife of human passions have often raged." Hugh Miller, in his *Geology of the Bass*, says—"I remember at one time deeming it not a little curious that the early geological history of a country should often seem typical of its subsequent civil history. If a country's geological history had been much disturbed . . . . . I found the chances as ten to one that there succeeded, when man came upon the scene, a history, scarcely less disturbed, of fierce wars, protracted sieges, and desperate battles." An interesting discussion upon various points raised in both papers followed, being taken part in by Messrs. John Young, F.A.S., James Thomson, F.A.S., Dugald Bell, Miller, and the chairman.

UNITED FIELD NATURALISTS' SOCIETY, MANCHESTER.—The quarterly meeting of this Society, which consists almost entirely of working men, was held on Sunday, December 9th, in the Art Museum, Every Street, Manchester. After the election of officers, Mr. Wm. Jones, Oldham, exhibited a number of wild and other flowers which were grown in the open air at Llandudno; Mr. Thomas Rogers, Manchester, a collection of marine shells from Australia, including recent specimens of old world types—*Terebratula*, *Kraussia*, *Trigonia*, *Spirula*, &c.; Mr. Wm. Chappel, Manchester, entomological specimens. Afterwards the members inspected the varied and interesting contents of the Educational Art Museum, for which the citizens of Manchester are mainly indebted to the generosity and fostering care of Mr. T. C. Horsfall, assisted by a council. In the course of the afternoon an instructive lecture "On a Grain of Wheat," was given by Mr. Hick, of Owens College, Victoria University.

NATURAL HISTORY SOCIETY OF GLASGOW.—The third meeting of the session was held in the Society's Rooms, 207, Bath Street, on Tuesday, 27th November, Mr. A. Somerville, B.Sc., F.L.S., vice-president, in the chair. Sir George H. Leith-Buchanan, Bart., sent on exhibition an immature example of the long-tailed duck (*Harelda glacialis*,) from Loch Lomond. Specimens lent by Mr. Henry Martin of the male and female bird in adult plumage were also exhibited, and remarks on the species and its habits and distribution were made by Mr. James Barrie, M.A., and others. Mr. Henry McCulloch showed an albino missel-thrush (*Turdus viscivorus*) from Sligo. Mr. Thomas Scott submitted a series of specimens of *Porcellio pictus*, an isofod crustacean found by him at Seafield, Leith, but apparently unrecorded for Scotland. Specimens of *Philoscia muscorum*, another isopod from Shielhill Glen, near Greenock, were exhibited by Mr. Andrew Scott. Mr. James Steel showed a specimen of the tail of *Trygon uarnak*, one of the sting-rays from China, and stated that the species, which is widely distributed throughout Asiatic waters, is remarkable for the comparative length and great pliability of its tail. In full-grown examples the body measures about 3 ft. in length, while the tail extends to about 9 ft. Mr. Thomas King, vice-president, showed specimens of *Stachys ambigua* and *Senecio saracenicus* from Inverary. Mr. R. S. Wishart, M.A., submitted a series of flowering plants from Boat of Garten, including *Alyssum calycinum*, *Cerastium arvense*, &c. Mr. D. A. Boyd showed specimens of *Panus conchatus*, *Polyporus lacteus*, *P. cæsius*, and other fungi from the neighbourhood of West Kilbride, Ayrshire. Mr. David Robertson, F.L.S., F.G.S., president, communicated a paper on "Loch Fyne Herring," in which the acknowledged excellence of these fish was directly attributed to the quality of their food. This consists largely of copepods, which have their bodies well supplied with oil-globules; but on the East Coast of Scotland these minute crustacea seem to be generally rejected by the herring in favour of shizopods and pelagic amphipods. A paper was communicated by Mr. P. Cameron, F.E.S., on "The Excessive Abundance of *Aphis dianthia* round Manchester in September."

CITY OF LONDON COLLEGE SCIENCE SOCIETY.—Some useful field meetings have been lately held by this active young Society. At Oxford the Gault and Lower Chalk was the subject of study; at Erith and Crayford an examination of the brick earth and River drift deposits was made. A new pit opened near the latter locality was found to be

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prolific in mammalian remains. Museum visits are also made a feature of this Society, the Museum of the Royal College of Surgeons having heen the scene of an interesting "demonstration". The Millwall Docks were visited on the 6th of December, under the guidance of Mr. F. E. Duckham (Engineer to the Dock Co.) At the December meeting Mr. H. W. Choat gave a paper on "Prehistoric Man," treating the subject in a popular yet graphic manner. We are not sure, however, that the author has brought his paper entirely up to date in his facts relating to Babylon and Egypt. At a subsequent meeting Mr. J. M. Bull, B.A., read a paper on the "Interdependence of the Highest and Lowest Forms of Life."

Obituary.

GEORGE ADAM MILLAR.—We deeply regret to announce the decease of this gentleman, which occurred on Sunday, December 2nd. By this sad event Keighley has lost one of its most useful and honoured townsmen, and the Scientific and Literary Society of that town one of its most active and sterling workers. He was connected with that society from its commencement, and had filled the office of president with marked success and ability. He displayed much interest in the work of the Yorkshire Naturalists' Union, and was a welcome attendant at the field excursions of the Union; he attached himself to the Geological Section, and his services at the Doncaster meeting in 1885 will not be easily forgotten. The Section was then in a moribund state, but Mr. Millar's energy on that occasion, in conjunction with a few others, gave it a new lease of life and started it afresh on its now successful career. His services to the cause of education were also very great, as evinced by his labours in connection with the Keighley Mechanics' Institute for thirty years, and his long and active support of the Cambridge University Education Scheme.

Jottings.

AT a meeting of the Geological Society of London, held on 7th November, Mr. DANIEL CLAGUE, the popular and well-known teacher of Geology and Mineralogy to the Liverpool Science and Art Classes, was elected a Fellow. Mr. Clague was one of the founders of the Liverpool Geological Association, and until lately occupied the position of honorary secretary.

LIVERPOOL CORPORATION LECTURES.—The annual autumn course of public lectures was this year marked by greater variety of subjects, in which Science held a prominent place. An innovation in the arrangements for admission was also made. The lectures had formerly been free, but in order to partly provide for a higher class of lectures and to add to the comfort of the audiences, who used to be disturbed by boys and others who were in no wise students, a small charge of a penny was enforced, or threepence for a reserved seat ticket. Penny lectures have been tried with success in many other towns. The lecturers at Liverpool included Professor Boyd Dawkins, F.R.S., on "The Bone Caves and the Early Inhabitants of Europe" (2 lectures); Mr. P. H. Rathbone on "Art: the Expression of a Nation's Character and Aspirations" (3 lectures); Sir Robert S. Ball, F.R S., on "Astronomy" (a lecture being each devoted to the Sun, Moon, Planets and Comets); Mr. W. Hewitt, B.Sc, (Science Demonstrator to the Liverpool School Board), on "The Principles of Geography" (4 lectures), and the Rev. W. H. Dallinger, LL.D., F.R.S., on "The World of the Minutest Life" (2 lectures) All these courses of lectures proved attractive, the scientific subjects especially so. Each lecture was illustrated by the lime-light. A more extended series of lectures will be given from January to April, the subjects of which will not be consecutive, the general admission to which will be, as usual, free. The Rotunda Hall, beneath the Picton circular Reading-room, is capable of accommodating 1,600 persons comfortably.

MR. W. EAGLE CLARKE.—Among the most interesting features of the meeting of the Yorkshire Naturalists' Union at Sheffield was the presentation of a testimonial to Mr. W. Eagle Clarke, F.L.S., on the occasion of his retiring from the honorary secretaryship of the Union, which he has occupied, along with Mr. Denison Roebuck, for several years. The following address formed part of the presentation:—"Sir,—Upon the occasion of your leaving Yorkshire in order to take up an important position in the Museum of Science and Art at Edinburgh, we desire, on behalf of the members of the Yorkshire Naturalists' Union and other friends, to express the sincere and deep regret which is felt at your removal from the county, and to offer you some permanent memento of their respect for your personal character, and of their high appreciation of your scientific ability. In your capacity as one of the honorary secretaries of our Union and editor of its journal, *The Naturalist*, as well as by your share in the authorship of the 'Vertebrate Fauna of Yorkshire,' you have not only manifested considerable ability as an ornithologist, but have contributed materially to the advancement of science in Yorkshire. We therefore beg your acceptance of the accompanying volumes of 'The Ibis,' together with a timepiece, as a small token of the esteem in which you are held by friends and fellow-workers, and in grateful recognition of the value of the services which you have so long rendered in promoting the detailed and systematic investigation of the natural history of your native county of York." The presentation was made by Mr. Hobkirk, who, in a few graceful sentences, gave expression to the mingled feelings of regret at Mr. Clarke's removal to Scotland, and of congratulation to him on the recognition of his scientific abilities, shown by his appointment to an important Government post, so generally felt by the members.

Letters to the Editor.

WHAT IS NATURAL SELECTION?

SIR,—"A phrase rich in ambiguities" says the Duke of Argyll; "good, because its meaning is not obvious," say other scientific men. Darwin himself was eventually not satisfied with it and would have preferred "Natural Preservation," but it had taken root and was not to be put aside. With Darwin it meant that nature does for its products what man does by artificial selection, an unerring power acting "exclusively for the good of each organic being." Natural selection, we are told, takes advantage of variations, "however slight"; but how can single variations be perpetuated? "Free crossings," says Darwin, "render the formation of new races impossible." Does, then, one sex select the other sex with a similar variation? On this point Huxley says the evidence is "not quite what we should like to have," and if there is no such selective breeding, "natural selection goes for nothing."

At present "natural selection" appears to be a phrase used to explain anything for which no other explanation is at hand.

FRANCIS P. PASCOE.

Answers to Correspondents.

T. MORRIS (Warrington).—We are obliged to you for the "slip" you sent, and are glad to find that our article coincided with views you have expressed in connection with the causes of fogs.

H. FISHER.—There is no better way for removing the water from the oil in question than by placing the mixture in a tank and allowing the water to settle out. The operation is best effected by keeping the mixture at a moderate temperature, say 80° Fahr. After the settling the water can be drawn off from the lower part of the tank.

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Research:

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NOTICES.

"Research" was recently increased by the addition of four pages, and, as will be seen in the last and present numbers, this has allowed of the insertion of a greater number of Reports of Societies' Meetings, &c.

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E. W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & Co. Price 3d., or by post, 4d. Annual Subscription 3s., or by post, 4s.

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Remittances and Communications respecting Advertisements, should be addressed to C. BIRCHALL, 32, Castle Street, Liverpool.

Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Woman's Work in Science.

IN publishing, in our present issue, the portrait and biographical sketch of a lady who is so favourably known as one of our most popular exponents of science-teachings, we may well call attention to the subject of woman's work in science, for when now-a-days women's occupations as means of livelihood are being increased in many directions—when we find women now doing excellent work in offices, in postal, telegraphic, telephonic and other similar establishments; when we see the ranks of the medical profession increased by well-trained and capable ladies, we may consider whether women can engage more generally than heretofore in science studies, either with the object of pecuniary profit or for intellectual occupation or pleasurable recreation. Now, as writers on science topics, we have many examples of ladies who, like Mrs. SOMERVILLE, Mrs. SEDGWICK, ARABELLA BUCKLEY, ANNE PRATT, MARGARET PLUES, the late Mrs. MERRIFIELD, and others, have largely aided the progress of science by their writings, and it is especially noteworthy that these ladies all show, not only a wonderful grasp of their subjects, but capacity of explaining them with clearness of detail in a manner thoroughly to be understood by any intelligent reader. Further accessions to the ranks of scientific authoresses would, we feel certain, do much to promote scientific studies and popularise scientific facts and theories.

Again, many examples might be given of ladies who have proved most successful as teachers of science, and there is no reason why, in female educational establishments, scientific instruction should not be imparted more generally than is at present the case by lady teachers who have themselves had a sound scientific training. We fear, however, that at the present time ladies have too few facilities afforded them for obtaining (except in some two or three of our large towns) that thorough instruction and training in science that can enable them to teach efficiently.

There are also numerous examples of ladies who have done and are doing excellent work in scientific laboratories—ladies whose work in scientific research is of the highest order; and again, in some few laboratories connected with sugar and other manufacturing establishments, certain special work is performed by females with perfectly satisfactory results. In this month's issue we chronicle the appointment of a lady—Miss E. J. MOFFET—as biological

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assistant in the laboratory in connection with University College of North Wales; and in the proceedings of the Liverpool Biological Society, which we had lately before us, there are reports of good work done by ladies; and we might add many other examples in this direction, as showing that not only can women undertake such work, but can do it well. Recent university pass lists include the names of many women students who have taken degrees in science, and it would be interesting to know in what directions they intend to make their knowledge serviceable.

In many scientific investigations we believe women would render valuable service, by reason of their capacity for clearly noting and contrasting details, the patience with which they pursue their work, and the delicacy with which they perform it. The very qualities which allow the opposite sex, often ungallantly, to satirise them for the readiness with which they will so quickly mentally summarise all the details of another woman's bonnet or dress, are just such as may be usefully utilised in many investigations requiring clear perception of facts, judgment as to resemblances and contrasts, and a careful summary of and reasoning on the whole. And we think that in many ways work in connection with science could help women to earn a livelihood; but there are many cases of ladies to whom the consideration of pecuniary results is not a necessity, who now pass their time in indolence, or who seek some occupation beyond the wearisome trivialities that too often make up the days of our girls, who would find in science studies occupation that would not only afford pleasure and profit to themselves, but allow them to add to the world's knowledge.

In connection with plant life, and natural history generally, there are many subjects which only require careful observation and record, without the aid of elaborate scientific appliances, to throw a flood of light on many now obscure points of scientific interest, and women with leisure, and desirous of doing useful intellectual work, could well undertake such inquiries. In microscopical investigations, also, women might do much; or, with more elaborate appliances and apparatus, other useful scientific work might be engaged in, and thus many an otherwise dull day be spent pleasantly and profitably, either during walks abroad or whilst at home.

We know that on the part of men there is a considerable amount of jealousy because of the encroachment of women in occupations which they have hitherto considered entirely their own; and that there is indisposition in many quarters to recognise and award honours for scientific work done by women. It is not long since that in certain scientific societies the question of admitting ladies to the fellowship was mooted, only to be scouted with derision by the majority of the members, notwithstanding that the ladies who were the cause of the question being raised had done most excellent scientific work. But gradually, we hope, these absurd and ungenerous jealousies will be broken down, and that it will be recognised that women are able to do really good work in science, and that when it is done it should have its reward.

We therefore strongly recommend greater attention by women to scientific pursuits, knowing that if they give it they will not only aid themselves but help the world in which they live.

The Formation of Dew.

By Dr. McPherson, F.R.S.E.

SCIENCE has no mercy on poetry; the hard reasoning of the physicist dispels the fantastic drapery of the sentimentalist. In our last paper we pointed out that the drops that hang, diamond-like, on the leaves and flowers on a summer morning are not dewdrops at all, but are only the exudation from the veins of the healthy plant. Tennyson's glorious picture of the embrace of lovers as "dewdrops on the petal that shake to the same sweet air, and tremble deeper down and slip at once all-fragrant into one" is rudely marred by the cold assertion of scientists that these are not dewdrops at all. The true dew is the lustrous film which is spread over dead and living leaves alike, without any suggestive touch of fancy.

Startling as to most is this distinction between true and false dew, it is no less curious to be informed that dew does not fall from the air. We are accustomed to be told that "early falls the dew," before the sunlight kisses it in rapture; yet dew does not descend from the heavens. Whence comes it, then? Did not Dr. Wells, at the beginning of the century, in his excellent *Essay on Dew*, establish the fact that vapour ascended from the earth during the day, and again descended as dew at night? Has not the investigation of that careful physicist been corroborated by every observer up to the present time?

Until three years ago men agreed with the conclusions of Dr. Wells; but, as in too many other matters, they did not take the trouble to verify the experiments. Mr. John Aitken, however, doubted the theory. He remembered Nardius' suggestion that dew was an exhalation from the ground; he read that Gersten advanced the idea of the dew rising from the earth. Accordingly he set to work to test the matter for himself; and in his famous paper on "Dew," in the *Transactions of the Royal Society of Edinburgh*, he has shown that his observations contradict the conclusions of Dr. Wells and support Nardius and Gersten.

Let us shortly enumerate his remarkable experiments in August and September. He first of all placed over the soil inverted shallow boxes or trays, made of tinplate and painted, about three inches in depth and a square foot in area. He examined these at 11 p.m. and in the morning. On all occasions there was always more moisture on the grass inside the trays than outside; there was always a deposit of dew *inside* the trays, and there was often no deposit outside the trays. This showed him that far more vapour rises out of the ground during the night than condenses as dew on the grass. The greater moisture inside and the heavier deposit of dew on the inner side of the trays proved that the exhalation from the ground was far greater than the deposit from the atmosphere. The trays prevented the moisture from escaping. His opinion was more strongly confirmed when, on placing the bulb of one thermometer on the grass, and that of a second thermometer among the stems of the grass, the latter frequently read as much as twelve degrees warmer. A thermometer placed deeper in the soil read even higher. This indicated that the warm air diffuses upwards with its burden of vapour until it reaches a surface cooler than the dew-point on which the moisture is condensed. On examining broad-leaved plants which were spread out near the surface of the ground, he observed that when the upper surface of the

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leaves was sometimes dry the under surface was heavily dewed. These leaves were nature's trays to explain the phenomenon.

It next occurred to him that, if vapour continues to rise from the ground during dewy nights, the ground giving off vapour must lose weight. Accordingly he applied this even more satisfactory test:—He cut a turf from the lawn, about six inches square and a quarter of an inch deep, and fitted it into a shallow pan. The two were carefully weighed with a balance sensitive enough to turn with a quarter of a grain. This was done at sunset, when dew was beginning to form. The pan with its turf were then rapidly restored to the lawn, and put in its place where the turf had been cut out, and in as good contact with the ground as possible. They were brought back and weighed again in the morning. What was the result? They weighed less than before. The turf had lost weight. This experiment was frequently made. In one case the small turf, freely exposed to the sky in the evening, lost from its weight of 3,500 grains no less than 24 grains in the space of five hours. He was thus assured that vapour really rises from the ground even when dew is forming; and that the dew then found on the grass must have been formed out of the vapour rising from the ground at the time. The cold grass, in fact, trapped the dew as it was rising in the exhalation from the warmer earth. The blades acted as a sort of condenser, and held back some of the vapour as it rose into the atmosphere.

Mr. Aitken next turned his attention to the investigation of the evaporation from ungrassed soil. Here he found that the inverted trays placed over the bare soil always showed a greater amount of condensed vapour inside them than those over grass. He weighed a small area of the surface soil, and placed this in a small pan. These he placed on the surface of the bare ground. After five hours he weighed the soil again, and found that it had lost about the same amount as in the experiments with the turfs. Still further to test the evaporation, he placed beside the tins, which contained turf and soil respectively, another set of the same weight and character. Over the latter he placed small trays; and he found, on weighing all, after being exposed for some hours, that there was a decrease in the evaporation from the turf and from the soil which had been covered by the trays compared with the evaporation from the exposed surfaces. In fact, the turf and soil covered by the trays lost only about one-fourth of the amount of moisture which was lost by those freely exposed to the air.

He observed, too, on several occasions that soil which had been dry the previous day was damp in the morning. Whence came that moisture? Did it come from the heavens above or from the earth beneath? His experiments led him to conclude that the latter was the true source. The higher temperature below determined the movement of the moisture upwards by the vapour diffusing; and the surface soil being cold, the vapour was trapped by it before it escaped into the air, in the same way as it was trapped by the grass on grass-land. In October, when on one evening the radiation was very powerful, the surface of the soil was covered with a thin crust of frozen moisture. On lifting the small clods he noticed that their under surfaces and sides, when close to each other, were all thickly covered with frozen dew so thickly as to be nearly white, while the upper surfaces had but little deposited on them. Why was this? The vapour rising from the hot soil underneath was caught in its passage through the cold clods; the moisture was rising from the ground, when it was seized by the cold surface and held fast in an icy grasp. Dew, then, rises from the ground.

Mr. Aitken thereafter made a careful examination of hard roads. He was doubtful of the current opinion held by scientists that dew is never formed on roads. After many experiments he was quite satisfied that that opinion was without foundation; for he found great abundance of moisture on roads in dewy nights. The stones are fairly good conductors of heat, and the dew is less seen on their upper surfaces; but it is found on their under sides. If a gravel walk be examined on a dewy evening the under sides of the stones will be found to be dripping wet, though little may be found on the upper sides. If a piece of slate be placed on the gravel, and another piece on a hard part of the road, on a dewy night, their under surfaces will be found to be dripping wet, though their upper surfaces and the road all round them may be quite dry. Vapour thus rises from hard, dry-looking roads on dewy nights; and dew is formed in all cases by evaporation from the earth. The escaping vapour rises till it meets with some surface not in good heat communication with the ground, and which has been cooled by radiation.

What nights are most favourable to the formation of dew? Clear and calm nights. Wind prevents its formation by mixing the hot air above the ground with the air cooled near its surface; thereby the air is prevented from being cooled down to the dew point for the deposit. Wind, also, by its passage over the surface of radiating bodies, prevents them from being cooled much below the temperature of the air, and carries away the vapour rising from the soil into a higher layer. Clear nights, again, are most suitable for the deposit of dew. Cloudless skies cause a strong radiation from the earth's surface, and the surfaces of bodies are cooled low enough to condense the vapour. Clear skies are also necessary in order that a copious evaporation may take place under a hot sun during the day; and the same conditions are necessary that the ground may store up the sun's heat during the day, which will be spent in evaporating an abundant supply of vapour during the night.

From these valuable experiments it is now generally concluded that dew does not generally fall on the earth, but is for the most part condensed from the vapour rising at the time from the earth. We must take another paper to show the influence of a covering of snow on the temperature of the air and the temperature of the earth.

A Scotch Volcano.

By Joseph Lomas, Assoc.N.S.S.,
Lecturer in Geology in University College, Liverpool.

VOLCANOES have a life history. There is a time when the heated materials from below first find a passage to the earth's surface, and round the vent begin to build up a structure more or less conical in shape. Then follows a series of changes, and at last the forces being spent, the activity of the volcano ceases and decay sets in.

In studying animals and plants we can get much information from observations made while the objects are living. But while we may learn the colour, or form, or distribution, there are many other features which only become apparent when the anatomist's scalpel has been at work.

It is so with volcanoes. In their active state we can note the general features of form, time and nature of eruptions, and distribution, but we get little knowledge of their origin and internal structure unless the scalpel of denudation is called to our aid.

Frost, moving water, and air are among the chief agents of denudation, and we find extinct volcanoes in every stage of decay.

Some, as the extinct volcanoes of the Auvergne Mountains, have only just begun to lose their sharp conical outlines, and we can readily distinguish the various lava flows and other surface features. Others have been cut deeper, and we discover layers of lava and ash, and even soils produced during periods of quiescence, and all these interlaced and crossed by dykes and intrusive sheets.

Still further penetrating we find the great frozen lake, which fed the volcano. This, having cooled very slowly, being deep down in the earth's crust, is usually composed of a highly-crystallized substance such as granite or gabbro.

The Western Isles of Scotland supply us with several examples of ex inct volcanoes, some of which have been cut down to the very heart.

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Professor Judd, F.R.S., has admirably worked out these examples, and in a series of papers published in the *Quarterly Journal of the Geological Society* has given us a full account of them.

One of these extinct volcanoes is situated in the Isle of Mull, and as this is perhaps the most instructive we will confine our attention to it.

Mull, in the Gaelic dialect, signifies a "lump," and anyone gazing on the island from the peninsula of Movern will see how appropriate is the name. It is seen to consist of lumps or hills, some of which rise to over 3,000 feet.

Standing at the mouth of the Forsa River the view up Glen Forsa is obstructed far up by a hill, Beinn Talaidh, which seems to stand alone, cut off by deep ravines from the surrounding hills. It is in shape a truncated cone, and has smooth slopes, a great contrast to the rugged cliffs which abound on the neighbouring hills. Surrounding this isolated mountain is a ring of lofty mountains, Beinn Creagach, Beinn Bhearnach, Beinn More, Beinn na h'Uaigh, &c., all of which are steep and precipitous, facing Beinn Talaidh, but slope gently away towards the coast in a radiating manner.

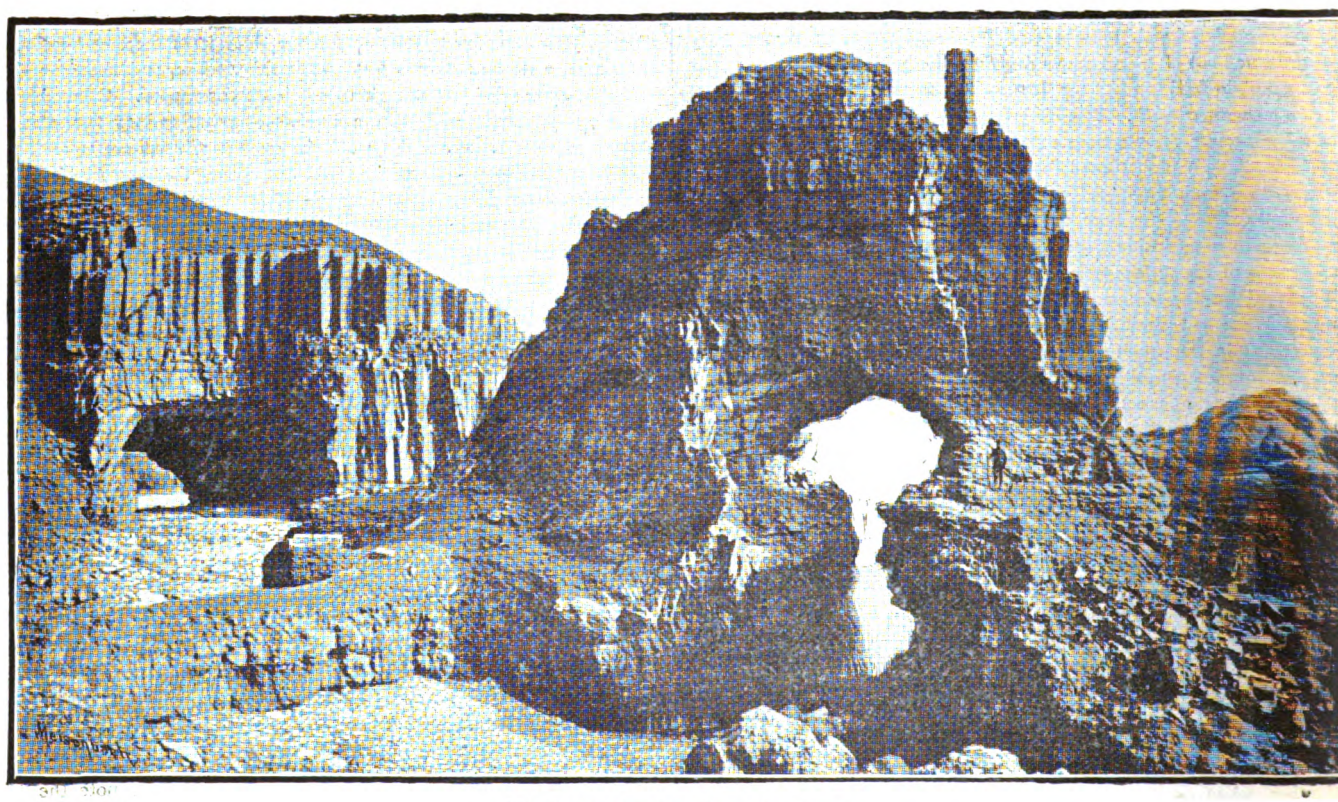
At some distance from the summit down the gentler slope of many of these hills there is a slight rise forming a shoulder. Thus another concentric ring is formed at an elevation of about 1,000 feet. Beyond this system of mountains we have extensive plateaux, stretching for some distance on each side. The Atlantic breakers have played sad havoc with these, especially on the west, and we find the platform has been cut up forming the numerous islands which cluster on the west coast, such as Ulva, Staffa, the Treshnish Isles, &c. The cliffs in some cases approach 1,000 feet high, *e.g.*, the Great Crags (Chreag Mohr) skirting Loch-na-Kael (see illustration), and the headlands of Burgh on the north side of Loch Scridian.

Looking at a map of Mull, geologically coloured, one is struck again with the concentric arrangement of the rock masses.

The central portion about Beinn Talaidh and Beinn Bhearnach is composed of crystalline basic rocks– gabbro and coarse dolerite. Completely surrounding this we have another highly-crystalline ring of rocks, but of an acid nature—granite, syenite, &c., and these are penetrated by dykes of a basic charracter. Surrounding this, and forming an almost continuous ring, we have volcanic agglomerates, some acid and some basic. Then succeeds a well-defined ring of acid lavas, felstones, &c.; and last of all the platform before mentioned, composed of basic lavas.

A little consideration will convince us that here we have the record of a volcano.

The crystalline masses forming the middle of the group represent the pipe up which the heated matters found their way to the surface.



NATURAL ARCHES, CARSAIG, MULL.

From a Photograph by Valentine & Sons, Dundee.

These pipes are not straight, smooth tubes, but are probably very much bent and contorted, sometimes vertical, sometimes horizontal, and varying greatly in width. So we should not expect to find a symmetrical mass of rock representing the frozen passage.

It is evident, too, that the same kinds of materials were not emitted at all the different periods in the life of the volcano. It is found in almost all recent volcanoes that acid masses are ejected first, and then intermediate or basic afterwards.

The volcano of Mull is no exception, as is seen by the fact that the acid rocks are penetrated by dykes and strings from the basic, whereas the basic rocks are never penetrated by acid varieties.

The order of events was most probably as follows:—First, a great outpouring of acid rocks, which formed a cone of considerable dimensions. The more crystalline rocks of the central portions represent

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the materials which were deep down, covered by extensive rock masses, and where cooling took place slowly. The surrounding felstones, often scoriaceous in character, represent the lavas, &c., which were poured out from the crater, and formerly made up the greater mass of the cone. Then followed a long period of rest, when the volcanic fires slumbered beneath the mountain.

Denudation—ever active—cut the mountain down to a mere wreck of its former self, and then from almost exactly the same vent the fires burst forth anew, and a new cone was built up composed of basic materials. This later cone must have been at least 10,000 feet high, and in turn it has been denuded till only a series of peaks remain, none of them much above 3,000 feet high.

The central crystalline basic rocks represent the masses which cooled slowly in the interior of the mountain, and the great plateau is made up of the lava streams and showers of ashes which issued from the crater. Long periods of time must have elapsed between the successive lava flows, for we find interbedded soils, formed from the disintegration of the lavas, covered and baked by other streams. In some cases we see evidences of old river valleys, and at Ardtun, on the south shores of Loch Scridian, beds have been discovered containing beautifully-preserved leaves of plants. These were probably imbedded in a great mud stream, such as frequently accompanies a great eruption, and being buried again by lava streams have been preserved. The vegetable remains have been made use of for determining the age of the volcano, and it is believed that the flora is of Eocene age.

The successive lava streams can be well examined in the great cliff sections, such as the Black Crags on Loch-na-Kael, and the upper and lower scoriaceous surfaces can easily be distinguished. In many cases the vesicles have been filled in by the infiltrations of silica or carbonate of lime, forming beautiful amygdules of chalcedony or calcite. The great masses of molten lava on cooling must of necessity shrink, and in doing so we find they give rise to columnar masses, more or less hexagonal in section. The columns are invariably arranged transversely to the cooling surfaces. In this way we have formed the wonderful columns of Fingal's Cave, the Clam Shell Cove of Staffa, and the picturesque arches at Carsaig. (See illustration.)

The basalt seems to shrink in all directions, and thus the columns are broken up by transverse joints, and the blocks thus formed, further shrinking, form concentric cracks which, being planes of weakness, cause the basalt to peel off when weathered, like the leaves of an onion.

This is the cause of the spheroidal weathering of basalt, and is exactly analagous to the perlitic structure which petrologists so frequently find in pitchstones and obsidians.

The molten matter in the pipe of a volcano, not content with sending matter to the surface, causes cracks to form in the surrounding rocks, and then injects them. When the crack is vertical, or nearly so, the injected mass forms a dyke but when the crack is horizontal, or sloping at a low angle, the mass when cooled is called an intrusive sheet. These injected masses on cooling shrink and form columns, which lie horizontally in the case of dykes, and vertically in the case of intrusive sheets. Being thrust in under great pressure the dissolved steam cannot readily escape, and so the rocks are compact, and not scoriaceous, at the upper and lower surfaces. In large dykes and sheets, however, there is frequently a line of vesicles about the middle of the mass. The outside portion becomes cold first and shrinks, but the interior remaining molten may expand to fill up the cavity, and thus the steam, being subject to less pressure, may escape and form vesicles.

The outer portions of a dyke or intrusive sheet often become cold and solid before the crystals have had time to form, and thus we may

CHREAG MOHR, LOCH-NA-KAEL, MULL.
From a Photograph by Valentine & Sons, Dundee.

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have a glassy material forming a selvage on each side. If the dyke be acid the glass is called obsidian, but if basic tachylyte. In all dykes it is found that the central portion is more coarsely crystalline than the sides. In Mull we find the rocks penetrated everywhere by these intrusive masses. Although their course is not always in a straight line, their general bearings show them to radiate from the central mountain group.*

When a volcano is becoming extinct it often happens that smaller vents appear on the slopes, and there form parasitic cones, or "puys," as they are sometimes called.

In Mull we find numerous examples, such as at Sarsta Beinn, a hill about 800 feet high, situated about three miles from Tobermory, and Beinn Hiant, in Ardnamurchan.

Mull is not the only volcanic fragment existing on the West Coast of Scotland. A line of extinct volcanoes runs from the North of Ireland—the Giant's Causeway is a portion of it—through Mull, Eigg, Rum, Skye, the Faroe Islands to Iceland, and there the volcanic fires have not yet ceased burning.

For further information on this subject I must refer the reader to Professor Judd's most admirable papers. It is only fair to say that Professor Giekie has lately published an opinion adverse to Professor Judd, in which he denies that volcanoes existed at all in the Western Isles, but rather great fissure eruptions took place which flooded the country with basalt, extending even to the Northern Counties of England. But in face of the facts stated above—the concentric arrangement, the succession of rocks, the radiating dykes, the formation of puys, &c.—I think no one can fail to see evidence of true volcanic phenomena.

The Compressibility of Water.

UNTIL about ten years ago the opinions of scientific men were very much divided about the compressibility of water. Some held that water was less compressible as the pressure was increased, and that there was a limit beyond which it could not be compressed further. Others with equal dogmatism declared that, so far as is known, water compresses proportionately to the pressure applied. At this conflicting stage, Professor Tait, of Edinburgh University, was entrusted by the "Challenger" Expedition Authorities with the investigation of the effects of enormous sea pressure on deep sea thermometers. During the last decade he has been making elaborate and difficult experiments, and on the evening of the 7th inst., at the request of the Council, he gave to the Fellows of the Royal Society, Edinburgh, an account of his work, with some of the startling results to which he had come in the course of his investigation.

The first difficulty that arrested his attention was the fact that water got heated by compression. This he showed by a simple experiment. Into a strong metal cylinder he poured cold water until it was quite full, and firmly plugged up the orifice. Attached to the cylinder were a compressing pump and wires attached to a galvanic battery. On the wall was placed a recording scale, the slit of bright light from the galvanometer moving to the right as the water became heated. With a pressure of two tons to the square inch, the recording light moved to the right hand, indicating that pressure generated heat in the water. In order to eliminate the effect of that heat he had to measure its amount; and here he encountered a second difficulty—the amount of heat evolved increased in a faster ratio than the pressure. A consideration of this remarkable circumstance brought him to the conclusion that water was more expansible the more it was compressed. This fact had been further forced upon him in submitting his gauges to a practical test at the depth of a mile and a half of sea. He had been struck by the difference between the result then given and that given in his laboratory in the University, until he remembered the difference of the temperatures in which the tests were made. Accordingly he had determined to work out the compressibility of fresh water at different temperatures with the "Challenger" apparatus.

He next showed the comparative compressibility of salt water and fresh water. He took a glass tube, about an inch in diameter and six inches long at one end, into which a fine tube had been sealed (about 24 inches long), turned at the lower extremity, and open at the end. The bulged end was closed. Into this fresh water was placed down to the turn in the small tube. A small quantity of mercury was then inserted. An indicator was put in, so that, when the one end of the mercury pushed up the water by reason of the pressure applied at the other end of the mercury, the indicator also moved up; and when the pressure was removed and the water returned to its former position, the indicator (by fine hairs) remained attached to the inner surface of the glass tube. In a second tube, of equal dimensions, he had salt water instead of fresh. These tubes were then placed into the test cylinder. Water pressure was applied up to two tons on the square inch; and on being removed it was found that the indicator had not been moved up so high in the salt-water tube as in the fresh-water tube. Before the exact amount of compressibility could be ascertained it would be necessary to take into account the compressibility of the glass in the tubes. But he stated that, after careful experiments, in which everything was taken into consideration, he found that salt water was one-tenth less compressible than fresh water.

Professor Tait then explained that the point of the maximum density of water (4° Centigrade) was lowered by pressure, and that the more water was compressed the less compressible it became. He then investigated, by algebraic calculation, the relationship of volume and pressure, and came to the conclusion, that if p represent the additional pressure in tons, the average compressibility of water per ton is $= \frac{0\cdot28}{36 + p}$. This brings out two startling facts: (1) that water is compressible only down to ·72 of its volume; and (2) that the internal pressure of the molecules of water is equal to 36 tons on the square inch.

After careful investigation of solutions of water with salt, he found that if s represent the percentage of salt in the solution, the average compressibility of the solution per ton is $= \frac{0\cdot28}{36 + p + s}$.

Professor Tait then dealt briefly with the effect of the compressibility of water on the mean depth of the ocean. He calculated that, on account of the compressibility of water, six miles of sea are reduced in depth by 620 feet. If the water of the ocean were to cease suddenly to be compressible, the effect would be that the mean depth of the whole ocean would be increased by about 116 feet, and that would involve the submerging of two million square miles of the surface of the land.

The Duke of Argyll on a Geological Curiosity.

THE Royal Society of Edinburgh has been rarely so crowded by Fellows as on the afternoon of the 14th Jan., when the Duke of Argyll read a paper, with suitable illustrations and specimens, on certain bodies, apparently of organic origin, from the quartzite beds near his Castle of Inverary. Among the audience were the Marquis of Lorne, Sir William Thomson, Sir Douglas Maclagan, Sir William Turner, Professor Blackie, Professor Tait, Professor Flint, Professor Blaikie, Dr. A. Geikie, Rev. Dr. Macgregor, Dr. Murray, Sheriff Irvine, Mr. John Aitken, Mr. Jolly, Mr. Peach, and many others.

His Grace remarked that, though the mountain-tops in Sutherlandshire were covered by a snow-white quartzite in which were cylindrical

* During a recent visit to Mull I took the bearings of some hundreds of dykes, and found, on plotting these out on the map, that they all converged towards Beinn Talaidh. Some dykes extend for great distances; I traced one for over twelve miles. See *Geological Magazine*, December, 1888, "On Some Additional Occurrences of Tachylyte in Mull," by Messrs. Kendall and Lomas.

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rods penetrating the whole substance of the rock, these rods were not found in the South and West of Argyleshire. What were these rods? Were they of mineral concretion or the marks of some organism? He was struck with the appearance of similar rods in the Inverary beds. Specimens of these he sent to Mr. Etheridge, the celebrated palæontologist in South Kensington, who was firmly of opinion that the rods were tubes or burrows of annelids. Originally, the Duke thought the marks were of vegetable origin; but after this opinion he investigated the habits of sand worms on the sea coast. He saw similar marks in the tubings of the sand. The tubes were exposed in transverse section, and were ovate in shape when the cylinder was cut at an angle. The same effect would be produced when the material had been disturbed by shearing or slipping of the beds or laminæ of deposit. Such movements, if not violent, would produce an elongation or pulling out of the cross section of the tubes, with resulting ovate forms. When the pressure was great the tubes were more or less crushed and flattened. When the tube had been preserved at all so as to show its original walls, those walls were traceable by a deposit of oxide of iron replacing the animal viscous matter which originally lined the sand. The substance inside the tube was found to be of a far finer texture than that without, this being produced by the selection of the worm of the finer particles in the assimilation of its food from the sand. The worm paths were of various forms, some vertical, others horizontal, others again loop-shaped. Club-shaped burrows, similar to those actually found from living specimens, were also found in the quartzite. In some of the specimens the brilliancy of the silvery mica, especially when seen in the sunlight and with a lens, traced out the ancient worm-paths with extraordinary distinctness. The oval rings of oxide of iron was one of the most marked characteristics of one of the beds. The absence of organic remains in the presence of such obvious metamorphism afforded no presumption whatever against their sedimentary origin. The indications of marine sedimentation were quite decisive, and, so far as this conclusion was concerned, the discovery of organic remains was by no means required. He was not surprised to find that these bodies, which he considered to be worm-casts, proved conclusively that the rocks in which they were found had been sheared over each other by movements due to subterranean causes. He lauded the work of MacCulloch and Murchison in a graceful tribute, which came in very happily in the presence of so many opponents of the old theory. The shearing and squeezing and elongation of the worm-casts had been observed by them, though they could not account for their presence in the quartzite of Sutherlandshire and their absence in that of Argyleshire. He was satisfied with the old observers—his teachers in geology—that the forms of their Highland mountains were due mainly to subterranean subsidences, with contemporaneous issue of plutonic and intrusive rocks; and the appearances in the quartzite exhibited were, on any conceivable theory of their origin, a convincing indication that such movements had extensively prevailed, and must have left a corresponding effect on the structure of their mountains. He was now convinced that the rods in the quartzite—which, in weathered surfaces, appeared like hob-nails in a labourer's boot—were worm-tubes made millions of years ago.

Dr. A. Geikie, of the Geological Survey, was of opinion that the bodies discovered by His Grace at Inverary were not of organic origin at all. He considered them to be due to the segregation of sulphide of iron, very possibly under the influence of decomposing vegetation. The surface had been, under the desiccating action of the sun, cracked up, and portions of the mould were swept out and rolled along the sea floor, becoming finally imbedded in the white sand, and by a process of mineralisation crystallised into those ovals.

Mr. Peach, of the Geological Survey, said he did not know whether the quartzites of Argyleshire should be paralleled with those of Sutherlandshire. There was no direct evidence that they were the same at all. The bodies described by the Duke appeared to be portions of spheroid bodies which had been distorted by mechanical movements; but they were not of animal origin.

Dr. Murray, of the "Challenger" Expedition, questioned whether these markings in the quartzites in the Highlands were worm borings at all. He would rather think that they were the markings of plants or reeds that had grown upon sand dunes. No doubt worms wrought wonders. The bottom of the ocean was one immense mass of excreta of worms; yet he was of opinion that the markings of the quartzite were more reasonably explained by vegetable rather than by animal deposit.

Other speakers followed, and the views expressed were keenly discussed, the markings being considered to be of animal, of vegetable, and of mineral origin by the several authorities present.

Notes in Brief.

Sir Henry E. Roscoe has been elected to represent the Royal Society on the governing body of Eton College.

A Lady Professor, of the High School at Stockholm, has gained the Bordin Prize of 3,000f., at Paris, for a treatise on mathematical physics. Mdme. Sophie Kovaleffska is to be congratulated!

Geography is a popular subject of study throughout the world. Not only are there published 130 serials in various countries devoted to the subject, but there are no fewer than 101 established Geographical Societies. Of this number, France has 29, Germany 22, and Great Britain and Colonies 9.

A survey has just been made of the newly-discovered Sutherland Falls on the West Coast of New Zealand, which are found to be 1,904 feet in height.

More "Musical Sand" has been discovered! Sand which emits a musical sound when disturbed by the hand or a stick has been lately found in Botany Bay, not far from the landing place of Captain Cook.

Fears were entertained that the Eiffel Tower was about to emulate the characteristic of the tower at Pisa. The safety of the construction now in progress at Paris appears, however, to be assured, and the structure has now reached a height of 730 feet, or 164 feet higher than the Great Pyramid of Gizeh.

A rare plant in Scotland, the *Scheuchzeria palustris*, only found in the bog of Methven, is now no more. A flight of 300 or 400 black gulls recently settled in the bog and devoured everything they could find in the shape of vegetation.

What is the nature of the poison formed in raw salted fish? For an answer to this question a committee of fishing firms on the Caspian Sea offer a prize of 5,000 roubles (£800 nominal) to the writer of the best treatise in English, French, German, Russian, or Latin.

Vesuvius is active once more, a new cone having been formed from which have issued two descending streams of lava.

Llandudno has been polled for the adoption of the Free Libraries Act, but the inhabitants do not appear to be desirous of possessing the advantages of a public library. 771 persons voted against and 626 in favour of the motion.

The parish of Camberwell, London, is more enlightened, for it has just adopted the Act by 11,407 votes to 7,050. The parish of Bethnal Green has just been presented by the Charity Commissioners with the site for a library and £5,000 towards a building.

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Under the auspices of the Wirral Farmers' Club, the farmers of Wirral (Cheshire) have become butchers — sparrow butchers — the slaughter during the last twelve months representing 12,750 sparrows. This wholesale destruction of these birds is a disgrace to the district and cannot fail, sooner or later, to react injuriously upon farming operations in the neighbourhood.

The trade in asbestos is steadily growing, and new uses are being found for this mineral. It has been utilised as a fireproof curtain for theatres, for fireproof paints, and as protection for workmen engaged round furnaces and in dangerous proximity to fires.

Mr. Halliwell-Phillips, the great Shakespearian collector, has bequeathed 300 volumes of letters from authors to the Edinburgh University. His collection of Shakespearian relics is to be offered to the Birmingham Corporation for £7,000, or if not bought to be sold by public auction.

Mr. William Ridley recently trapped a grand specimen of the rough-legged buzzard on Stublick Moor, near Allendale Town, Northumberland. The bird measures 56 inches in length from tip to tip of wing, and is in fine plumage. It is believed that this is the first of its kind killed in the locality for a number of years.

At a meeting of the council of University College, North Wales, a letter was read from the Privy Council, announcing a grant to the College of £200, in aid of agricultural education and dairy farming.

The report of the senate of the same University mentioned the appointment of Miss Elizabeth J. Moffet, as biological laboratory assistant to Professor Phillips.

The visit of the British Association to Bath has resulted in a profit of £950. It is intended that this money should form a nucleus of a fund for building an Art Gallery in Bath.

Mr. Fred. Challis, the Museum, Chelmsford, calls our attention to the interesting appearance and phenomena presented by a soap bubble if, before it is thrown off from the pipe or tube, a few whiffs of tobacco smoke are blown into its interior. Possibly, some of our readers may wish to note the results of such an experiment.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between December 16th and January 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(a)	Barometer	Highest (January 3rd)	30·73 Inches
,,	,,	Lowest (December 21st)	28 81 ,,
,,	,,	Mean	29 871 ,,
,,	,,	,, for 21 years December	29 863 ,,
,,	,,	,, ,, January	29·901 ,,
	Temperature	Highest (December 19th)	50·1 Deg. F.
	,,	Lowest (January 5th)	22 2 ,,
	,,	Mean	38·2 ,,
	,,	,, for 21 years December	39 7 ,,
	,,	,, ,, January	39·1 ,,
	,,	of Evaporation	36·5 ,,
	,,	,, for 21 years December	3·0 ,,
	,,	,, January	37·4 ,,
(b)	Rainfall	Amount	1·133 Inches
,,	,,	,, Mean for 21 years December	2 733 ,,
,,	,,	,, ,, January	2·284 ,,
	,,	Number of Days on which Rain fell	13
	,,	Greatest fall in 24 Hours (December 27th)	0·331 Inches
	Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·8
	,,	,, for 21 years December	6 9
	,,	,, January	7·0
(c)	Wind	Velocity, Greatest (December 21st)	40 Miles.
	,,	,, Least (December 30th)	1 ,,
	,,	,, Mean Hourly	14·5 ,,
	,,	Greatest Pressure on Square Foot (Jan. 9, 0·25 p.m.)	24·3 Pounds.
	,,	Direction at time of Greatest Pressure	WSW

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
38	65	284	114	66	59	41	77	0

Notes.

(a) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(b) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(c) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

From the 15th to the 30th December the weather continued very mild, but on the 31st the temperature lowered considerably. Hail fell on the 25th and 27th. Fog occurred on the 15th, 16th, 18th, 28th and 31st; and hoar frost on the 27th, 29th, 30th and 31st.

During the week ending December 21st the mean barometric pressure was 29·981 in., with a range of 1·34 in.; corrected mean temperature 40·97° (about 7° higher than corresponding week last year); duration of bright sunshine only 54 minutes on the 17th; relative humidity 92%; rainfall on the 3 last days 0·21 in.; direction of wind S.E.; force variable. From the 22nd to the end of the month the barometer made 7 oscillations, with the low mean of 29·647 in. The mean temperature ranged from 46·98° on the 22nd to 30 4° on the 31st, with a mean for the 10 days of 38·21°; sunshine on the 29th and 30th 6 hours 11 minutes; humidity 88%; rain on 7 days 1·719 in.; prevailing wind easterly.

The month throughout was warmer than the average, and in remarkable contrast with the previous two Decembers. In 1886, 1887, and 1888 the means are 34·6°, 37·02° and 40·88° respectively. The cloudy, humid atmosphere prevented more than 11½ hours of sunshine, distributed over 6 days. The mean barometric pressure, 29·916", was slightly above the average; humidity 89%; and rainfall 2·684 in. (about 1·5 in. below the average); rain fell on 16 days; no snow; hail on 2 days; fog on 7; no gale or thunder.

The year just ended presents some points of character worth noticing. The average barometric pressure 29 941 in., of mean temperature 45·31°, of the temperature of the soil 46·4°, are all practically the same as in 1887; and yet how fondly we think of the former period. Other columns in the register explain wherein the contrast lay :—Humidity 5% more; rainfall 37·985 in. (although below the average, was nearly 10 5 in. more than in 1887); rain fell on 195 days, against 151 in the previous year; the hours of sunshine were 789, against 1,132 (a difference of 31% against the latter year in one of the first necessities of plant life); sunny days 217, against 270. During the first six months the rainfall was much below the average, May contributing only 0·75 in. Following the exceptionally dry period of 1887, the scarcity of moisture caused agricultural crops to suffer; while the showery, cold weather of July, August, and beginning of September delayed the harvest of cereals beyond the usual time.

The week from January 1st to 7th had all the necessary elements for fog manufacture—high pressure, humid, and almost absolute calm; the effect was, more or less foggy every day. Frost was registered each night except the 2nd; hoar-frost on the 4th, 5th, and 6th. Barometer reached 30·743 in. on the 3rd, and for the seven days the mean was 30·373 in.; mean temperature 32·44°; rain on the 6th 0·013 in.; no

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sunshine; calm every day. From the 8th to the 14th the weather was milder; barometer unsettled, range 1·5 in., mean 29·739 in.; mean temperature 38·58°; rainfall 0·167 in. on the 9th; sunshine 5·43 minutes on the 10th and 11th; no frost; and fog on the 14th.

W. W. Midgley, F.R.Met.S.

Met. Observatory, Bolton, January 17, 1889.

The Weather, December 16, 1888, to January 15, 1889.

The high pressure area which extended over the kingdom on the 15th continued on the 16th, with the barometer ranging between 30·20 in. and 30·50 in., but it gave way decidedly on the 17th and 18th, and fell to 29·90 in. in the North, but was as high as 30·20 in the South. The decline of pressure continued on the 19th, falling to 29·40 in. in the North, and 29·60 in. in the South. On the 20th it was low but steady, and a further fall occurred on the 21st, when a depression from the West caused the barometer to fall to 29·0 in., and it remained low on the following day, when the centre of the depression was over Ireland, and the readings there were as low as 28·70 in. On the 23rd there was a gradual increase of pressure to 29·50 in., and a fall again on the 24th to 29·0 in. in the North, increasing to 29.50 in. in the South. Pressure was much the same on the 25th, though an approaching depression from the West caused a further fall in Ireland, but this soon filled up, and there was a rise of the barometer on the 26th, and on the 27th it varied between 29·50 in. in the North, and 29·95 in the South, but gave way again the same day, and only ranged from 29·20 in. to 29·50 in. on the 28th. A brisk rise took place the next day, and pressure was tolerably even over Britain, ranging from 29·80 in. to 29·90 in., and on the 30th it was above 30·0 in. all over the country, but fell to 29·70 in the North on the 31st. On the 1st of January pressure was high and even, varying only from 30·06 in. to 30·16 in, and anticyclonic conditions prevailed till the 5th, with pressure above 30·50 in. in most places. The anticyclone gave way on the 6th, and the barometer was slightly below 30·0 in. on that and the following day, and on the 8th there was a decided fall to 29·40 in. in the North-West, and 29·90 in. in the South-East, the decline continuing on the 9th, and the depression travelling away to the South-East on the 10th with a brisk barometrical rise behind it. It fell again in the West on the 11th, and pressure was low and irregular on the 12th, but on the 13th it rose to 30·0 in., and the barometer was slightly above that height all over the kingdom on the 14th. On the 15th another depression from the West caused the barometer to fall to 29·70 in. in the North-West, but it was as high as 30·20 in. in the South-East.

	TEMPERATURE.							RAINFALL.				
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	* Means for December. Daily Max.	Daily Min.	Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Dec.* Ins.
Sheffield ...	57°	5th	26°	14th	42°	—	—	2·04	14	0·19	25th	—
Spurn Head.	55°	4th	28°	14th	42°	—	—	1·03	15	0·35	27th	—
York	59°	5th	23°	19th	40°	43°	32°	1·72	15	0·86	27th	2·45
Barrow	52°	5th	29°	31st	42°	—	—	2·97	17	0·59	3rd	—
Liverpool ...	58°	5th	26°	18th	42°	44°	36°	1·38	18	0·33	27th	2·70
Holyhead ...	56°	6th	33°	31st	46°	47°	39°	3·30	21	0·49	27th	3·84
Oxford	58°	4th	25°	11th	41°	44°	34°	2·18	12	0·75	8th	2·13
London	58°	5th	25°	13th	41°	45°	35°	1·04	15	0·22	24th	2·14

* The means of Temperature and Rainfall for December are for 15 years.

Temperature was above the average at all places.

From the 16th to the 22nd of December the weather varied considerably, being dry, cold, and foggy during the first half of the week, and mild and wet, with strong winds during the last half. The fog was especially thick on the 17th and 18th. There were severe frosts in many places from the 16th to the 19th. Rain fell on 5 days at Holyhead, and the weather there was mild the entire week, the mean temperature of the week being 3° above Liverpool and London. There was rain on 4 days at Sheffield, York, Barrow, Liverpool, and Oxford, and 3 days at Spurn and London. During the week ending Dec. 29th the mild, unsettled weather continued, and temperature was decidedly above the average, the maximum readings varying between 40° and 50°, and there was no frost till the end of the week, but on the 29th temperature fell considerably, and there were sharp frosts during the night in nearly all parts of the kingdom. There was rain on 7 days at Spurn, 6 days at Liverpool and London, 5 days at York, Barrow, Holyhead, and Oxford, and 4 days at Sheffield. During the week ending January 5 anticyclonic conditions prevailed, and the weather was cold and foggy, except in the North and West, and there was very little rain anywhere. On the 5th the maximum temperature was only 24°, or 8° of frost, and at several other places temperature did not rise above the freezing point. This was the coldest week there has been this season. There was rain on 2 days at Sheffield, York, and Holyhead, on 1 day at Spurn, Barrow, and Liverpool, and no rain at London or Oxford. Temperature was very low at the beginning of the following week (January 6th to 12th), and keen frosts were experienced in most places, with snow in the eastern parts of the country; but on the 8th the air became milder, and there was scarcely any frost during the remainder of the week. Fogs were prevalent till the 8th. From January 13th to 15th the weather was cold, with rain and sleet at many places, and there was very little fog anywhere. From January 6th to the 15th (10 days) rain fell on 7 days at Spurn, 6 at Sheffield, 5 at York, Holyhead, and Oxford, 4 at London, 3 at Barrow, and 2 at Liverpool. The snowfall this winter has, up to the present, been remarkably light.

Sun Spots.

Sun spots have been few this month. On December 17th there was a group of half a dozen rather faint and widely-separated spots past the centre of the disc. This outburst was evidently recent, for the sun was spotless on the 15th, and it soon subsided, for the next time the sun was visible, on the 22nd, there were no spots on its surface, and it has been time spotless every the weather permitted an observation to be made up to January 15th.

Astronomical Occurrences in February.

The moon was new on the 31st January, and there will be no new moon in February. The moon enters her first quarter at 8-58 p.m. on the 7th, is full at 10-17 p.m. on the 15th, and enters her last quarter at 11-55 p.m. on the 22nd. Two stars above the 6th magnitude will be occulted by the moon in February, viz.: a 5½-magnitude star in Taurus on the 9th, disappearing at 6-46 p.m., and reappearing at 8-2 p.m, and a 5½-magnitude star in Gimini on the 12th, disappearing at 7-41 p.m., and reappearing at 8-31 p m. A 4th magnitude star in Cetus will make a near approach to the moon at 7-6 p.m. on the 6th. Venus is an evening star, and is so brilliant this month that it may be seen in the day-time, and is plainly visible long before the evening twilight has faded. It sets at 9-19 p.m. at the beginning of the month, and at 10-10 p.m. at the end, or about 4½ hours after the sun. It attains its greatest eastern elongation on the 17th, when it will have the appearance of the moon at its first quarter, and after that date it will become more concentric in form. Mars is an evening star, and sets about 8 p.m., but it is not well placed for observation, and the same remark applies to Jupiter, which is a morning star, rising about 2½ hours before the sun. Saturn comes into opposition with the sun on the 5th, and is therefore visible all night, and well placed for observation. The rings are decidedly closing, and the details of the system becoming more difficult to make out, and the ring will be quite invisible in small telescopes after next year.

E. Howarth, F.R.A.S.

Weston Park Museum, Sheffield, January 20th, 1889.

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The Temperature Near Warrington.

Mr. James E. Worsley has favoured us with an analysis of the weather near Winwick for the twelve months ending December, 1888. The records were taken daily, and have been carefully detailed. It is much to be desired that observers in other districts would follow in the same careful manner the variations of temperature and meteorological conditions of their own neighbourhoods, for it is only by an increase of systematic work in this direction all over the country (much of which can be prosecuted with little expenditure by private individuals) that real progress in the science of Meteorology can be made. We have not space to give Mr. Worsley's results in full, but the following summary may be useful :—

1888.	Mean Temperature.	BAROMETER. Highest.	Lowest.
January	37°	30·58°	29·10°
February	36°	30·39°	29·36°
March	34°	30·30°	28·74°
April	44°	30·20°	29·42°
May	52°	30·78°	29·12°
June	55°	30·21°	29·48°
July	58°	30·06°	29·32°
August	57°	30·22°	29·51°
September	67°	30·38°	29·71°
October	45°	30·40°	29·30°
November	45°	29·98°	29·16°
December	40°	30·39°	28·88°

Our Portrait Gallery.

VIII.—ARABELLA BURTON BUCKLEY. (Mrs. Fisher.)

AMONG those who have laboured in our day to render science generally intelligible and attractive, few have obtained a wider popularity or achieved results of more solid value than the subject of our present notice. Mrs. Fisher, more generally known to the world as Miss Arabella Burton Buckley, is the youngest daughter of the late Rev. J. W. Buckley, and was born October 24, 1840, at Brighton, where her father then held the sole charge of St. John's Church. In 1844 Mr. Buckley was presented to the Vicarage of St. Mary's, Paddington, and consequently removed to London, where Miss Buckley received her education under masters who found much to commend in her love of knowledge, but much to reprove in her habit of being violently interested in anything rather than the actual subject of the lesson. As she grew up, and sisters left home, a large share of parochial work came to devolve upon her, which called her remarkable industry and faculty of organisation fully into play. Her aspirations after literary culture nevertheless, claimed a wider scope and in June, 1864, happening to hear through her friend the late Miss Frederica Rowan, Secretary to Sir Francis Goldsmid, that Sir Charles Lyell required a lady amanuensis, she applied for the post, and obtained it, principally on account of the clearness of her handwriting. From that time to Sir Charles Lyell's death in February 22nd, 1875, she worked with him for four hours daily whenever he was in London, except for six months in 1869, when she left to go to a sister in Italy. During her absence Sir Charles tried three other amanuenses, and finally gave up work and travelled until Miss Buckley could return to him. The amanuensis had become the secretary and indispensable literary assistant. Miss Buckley not merely wrote Sir Charles' letters after his instructions, and ordered his very extensive scientific correspondence, but when a new edition of any of his works was called for she drew illustrations, re-cast passages, made *précis* of information in new works, corrected the proofs, and compiled tables and indexes. Sir Charles, on his part, amply repaid her, both by his own warm friendship and that of Lady Lyell, and by the opportunities he afforded her of acquaintance with the numerous eminent men who frequented his house—Herschel, Tyndall, Huxley, the Duke of Argyll, Hooker, Grove, Wheatstone, Spottiswoode, Dean Milman, Lecky, Colenso, Martineau—above all Darwin, who came but rarely to town, but when there, would come after his early breakfast to chat with the Lyells over their's. These conversations, to which Miss Buckley was always invited, led to a friendship founded on deep reverence and admiration for a grand and simple nature on the one side, and on the other to that kind appreciation which Darwin of all men knew best to show for younger workers. Miss Buckley's first literary attempt was an anonymous essay on Darwin's "Descent of Man" in *Macmillan's Magazine*, for May, 1871, entitled "Darwinism and Religion," pointing out that "the evolution theory neither shuts out God, degrades our conscience, checks our belief in the power of communion with the Divine mind, nor diminishes our hope of immortality."

Lady Lyell died in 1873, and no more social gatherings took place at the house in Harley Street. But work continued to within two days of Lyell's death, when he had read to him in bed the last pages of the eleventh edition of the "Principles of Geology." Miss Buckley's affection for her teacher and master has remained undiminished, and she has lost no opportunity of pointing out the great position which he holds in the history of scientific thought, from having, more than any other man, contributed to familiarise the public mind with the principle of gradual continuity in the operations of nature, the foundation of all theories of evolution and development. Years afterwards she was enabled to devote an article to his memory in the "Encyclopædia Britannica."

Some months before Sir Charles Lyell's death, Miss Buckley had begun in spare moments her first work, "A Short History of Natural Science." Eleven years of apprenticeship told, and Mr. Murray at once accepted the book, which appeared in the autumn of 1875. A fourth edition has just been published, carefully corrected and brought down to the present time. It was succeeded (1876)

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ARABELLA BURTON BUCKLEY

(MRS. FISHER).

From a Photograph by C. Vandyk, London.

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by a revised edition of Mrs. SOMERVILLE'S "Connexion of the Physical Sciences," also published by Murray. In this year it was proposed by influential friends that Miss BUCKLEY should succeed to the headship of Girton College, vacant by the resignation of Miss DAVIES, but this, for various reasons, she declined, and after an unsuccessful application for the head mistresship of a high school for girls, devoted herself to lecturing and authorship. During 1877 she lectured at Milton Mount College, Gravesend, on geology and botany, which led her to compile her "Botanical Tables," published by Stanford in the same year. In 1878 she delivered in Canon Duckworth's schoolroom, in St. John's Wood, the lectures afterwards so widely celebrated as "The Fairy Land of Science," the most popular of her writings. They were published under this title by Mr. Stanford, by whom all her scientific writings are now issued. In 1880 appeared her popular history of the invertebrata, entitled "Life and Her Children;" and in 1882 she produced her corresponding work on the vertebrata, entitled "Winners in Life's Race." All these works have enjoyed a large circulation in America as well as in this country, and the "Fairyland" has been translated into Danish and Polish. In 1883 Miss BUCKLEY'S father died, and in 1884 she married Dr. T. FISHER, and took up her residence in Devonshire. Her principal literary work since this time has been of quite a different character to the former, being an abridged history of England, written at the request of Messrs. Macmillan, and published by them in 1887. The qualities evinced in her other writings are equally conspicuous in this, which holds its ground successfully, notwithstanding the great number of competitors. Since this period she has only written scientific articles in periodicals.

Miss BUCKLEY has earned a high place among the authors of her day, and not merely among its expositors of science. She possesses, in an unsual degree, the lucidity which is necessary to make science clear, and the imagination which is requisite to render it attractive. The former quality is apparent everywhere, notably in such passages as the exposition of the anatomy of the humbler orders of creation in "Life and her Children;" or the explanation of natural phenomena in "The Fairy Land of Science." The secret of her no less habitual attractiveness is her earnestness and passionate desire to be helpful. She has thoroughly assimilated her subject, and is for the moment wholly inspired by it. In such passages as the description of the evening walk, leading to the observation of the habits of the Rodents ("Winners in Life's Race") she rises into poetry; and when, as towards the conclusion of this treatise and its companion, she enforces a moral or dwells on the religious or philosophical aspects of science, she attains the elevation and dignity of true eloquence. Her "Short History," however, is probably the work on which her celebrity will mainly rest. It is scarcely possible to conceive of it as superseded, for it is difficult to imagine of anything better of its kind. Thus far, at least, it holds the field without a competitor in our language; combining human interest with scientific interest to a degree implying the co-existence in the writer of faculties not always or often found in union. Mrs. FISHER'S is one of those large natures which include within themselves powers susceptible of very diverse application, and whose actual direction is in great measure the result of accident.

R. G.

Pallas's Sand Grouse.

THE chief ornithological event of the year 1888 has been the occurrence in England, in such large numbers, of Pallas's Sand Grouse (*Syrrhaptes paradoxus*). This bird is a native of the centre of Asia, and thirty years ago there was no recorded instance of it ever having found its way to England, and since then its visits have been few, and no satisfactory reason has yet been assigned for its invasion of Europe at long intervals and in large flocks. The first occurrence of Pallas's Sand Grouse in England was in 1859, when a male bird was obtained in Norfolk and sent to the Lynn Museum. In the same month another male was shot from a flock of three, near Tremadoc, in North Wales, and secured for the Liverpool Museum, and the curator of that institution, Mr. T. J. Moore, gave a full and illustrated account of it in the *Ibis* for 1860. A further specimen was obtained in Kent, and these three are the only specimens known to have been obtained in Britain till 1863, when there was a great invasion of them, hundreds reaching our shores and extending westward to Ireland, these being, however, but a small portion of the vast horde that left their eastern home to visit Europe. The first occurrence recorded in England in 1863 was at Thropton, in Northumberland, on May 21st, and from that date till the end of June fresh flocks were continually seen in various parts of the kingdom.

The great interest taken in these rare visitors produced the usual result, and they were ruthlessly shot and completely exterminated, though there is good reason to believe that, if left alone, they would have bred here and probably remained with us, for in some of the districts out of the range of the malign influence of the collector they remained till the end of the year, and the last survivor was not exterminated till February, 1864, when it was shot in Pembrokeshire. In Denmark, Holland, and Belgium the sandhills of the coasts formed a congenial resting place for them, and many flocks took up their homes there, and several clutches of eggs were obtained. After 1863 there is no further well-authenticated record of the occurrence of these birds in Britain until 1888 (though they were said to have been seen in 1874 and 1876, but no specimens were obtained), and then they invaded us in much greater numbers than in 1863.

The first notice of the advance of the Sand Grouse into Europe in 1888 was given by Dr. Meyer, who stated that it had been seen at Plock, in Poland, on April 21st, and before the end of April it had made its appearance in Saxony, Prussia, Hanover, Hungary, Silesia, Bohemia, and other European States, and the invasion continued throughout the month of May. On May 8th the first flock, consisting of twelve birds, was seen at Heligoland, and until the 25th of the month large flocks were frequently passing that island on their westward migration. The first record of its occurrence in England in 1888 was in Hampshire on May 15th, when a flock of twenty was seen, and after that date it was very generally met with throughout England and Scotland, the first recorded appearance in

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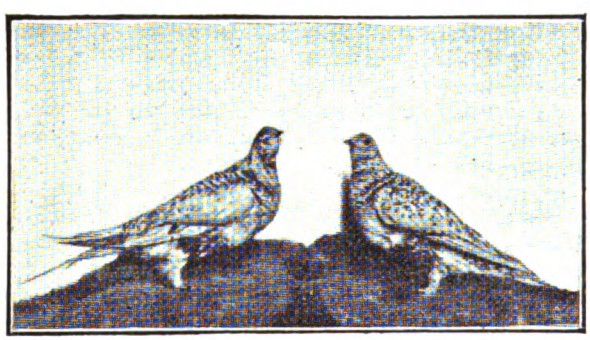
Scotland being May 16th, at Dunbar. In Ireland it appeared in county Clare on May 26th, and in county Down on May 30th. The birds, on their first arrival, were not at all timid, but could be approached with tolerable ease, though the reception they met with scarcely justified such confidence. Several specimens were captured alive, and of these, three are now living in the Zoological Gardens, London. The birds were evidently inclined to breed in England, for several clutches of their eggs have been found, but the rapacity of the collector, and the ignorance of other people, have prevented the attempts to breed being successful. As an example of the wholesale destruction of the bird, it may be mentioned that a gentleman had fourteen grouse offered to him at 2s. 6d. a brace, and they were all Sand Grouse, but at the time neither the seller nor the buyer had any idea of the rarity or value of the bird.

Mr. Swales, of Beverley, Yorkshire, who obtained a clutch of eggs, gives the following account of the nesting of the Sand Grouse in his neighbourhood:—"Two clutches of eggs of this bird were taken in the East Riding last summer—one on the 15th June, on Newbald Lodge Farm; the other on the 5th July, at High Gardham, both places, which are near together, being within ten miles of Beverley. The nests in these instances were made in cornfields, between the rows, and were similar to nests of the green plover—a scratching about 8 in. across, 1½ in. deep, and carelessly lined with grass. On the 29th June a third nest was found near the same place, also in a wheat field, but unfortunately, the two eggs which it contained were smashed by the searcher putting his foot on them." A nest with three young was also found near Durham in July, and eggs have been found in other places, though some of the reputed finds are doubtful. The number of eggs in a clutch is usually, if not always, three.



Pallas's Sand Grouse is a handsome bird, of a buff, sandy colour, with dusky streaks on the head and back, an orange band on the back of the neck, and another on the throat, and a narrow band of black feathers on the chest, this being succeeded by a still broader dark band on the belly. The legs and feet are covered with short, dirty-white feathers. The wings are long and pointed, and the centre pair of tail feathers are produced into two long filamentous tips, which exceed the length of the other tail feathers by 3 in. These tips are not so much produced in the female, which is also without the narrow black band on the chest. The flight of the bird is very rapid, and probably equal to that of the swiftest falcon, but it is not a quick runner. As previously stated, it is a native of Asia, and its migrations have usually been confined to that continent, going north into Siberia for its breeding and south to Mongolia and Turkestan afterwards; and why it should have occasionally migrated to Europe in such large flocks is one more of the mysteries connected with bird migration. Professor Newton, who prepared an exhaustive account of its appearance in England in 1863, is engaged upon a similar record of last year's invasion, and he will, perhaps, be able to throw some light on the question. Paucity of food, a migratory blunder, or severe weather blocking its usual route may furnish some explanation of its appearance here, but, whatever the cause may be, it is a handsome and interesting bird, and a welcome addition to our avifauna. Parliament, in its Autumn Session having passed a Sand Grouse Protection Bill, it is to be hoped the bird will become a regular visitor, if not a resident, in our country. The fact that specimens of the bird have been recently seen in England shows a probability of it remaining with us if properly protected. E. HOWARTH.

Reviews.

Museums and Art Galleries. By Thomas Greenwood, F.R.G.S.
[London: Simpkin, Marshall and Co. 1888.]

MR. GREENWOOD has followed up his recent publication on "Free Public Libraries," which met with so much success, by a companion volume dealing with the Museums and Galleries of the country. The work is especially to be welcomed, coming at a time when renewed public interest in these institutions is beginning to be apparent. It is correctly stated in the preface that the only literature relating to Museums has hitherto been found in contributions to magazines, or occasional papers read before learned societies. The British Association has lately, however, given special attention to provincial Museums, and two valuable reports have been drawn up by a specially-elected committee for the purpose, of which Mr. F. T. Mott, of Burstall Hill, Leicester, is the honorary secretary. The work done by this committee needed cohesion, and the volume now before us may be said to usefully supplement the records published by the British Association. We believe that, until the subject was taken up systematically in our own pages, no other magazine had attempted lengthened and consecutive descriptions of the contents and history of the public Museums of our country, nor had any journal devoted space to the regular insertion of items of intelligence affecting Museum curators and the general public who are interested in these institutions. The series of articles which we have initiated will be found to contain fuller information of individual scientific collections in public Museums than has yet appeared elsewhere. Mr. Greenwood's work will be heartily welcomed by a large section of the public. The author does not claim for his book the standing of a scientific treatise, but has collected together a vast amount of information, statistical and other, bearing upon Museums and Art Galleries, all the more valuable through being contained in a convenient compass and arranged for ready reference. After giving particulars, accumulated with great labour, of nearly two hundred Museums of the country, Mr. Greenwood has had the conviction strongly impressed upon him that it is only the rate-supported Museums which are doing really useful work. Museums supported by subscriptions and voluntary donations, he remarks in his preface, are in a state of decrepitude and decay, many of them being almost ready to close their doors from lack of public support and interest. In many of these places, however, the adoption of the Free Libraries and Museums Acts would produce a new lease of healthy life in the respective neighbourhoods, and existing Museums could well be made a nucleus for such efforts. The main objects of a Museum are classed as follows:—1. That it provide rational amusement of an elevating character to ordinary visitors. 2. That it be an educational institution easily accessible to all classes. 3. That it provide a home for examples of local natural history or antiquarian objects. 4. That a section of it be a commercial Museum, containing specimens of local manufactures. There is need, too, the author considers, for one central institution in a given district, around which shall centre the intellectual life of the town. The providing of a place of exchange for duplicate specimens is, again, one of the pressing requirements of Museums at the present time.

A number of opinions are quoted from leading curators in Great Britain on the question of what they considered the best means of extending the work of Museums generally, and of increasing their individual utility. Amongst the numerous suggestions received in reply are many of considerable practical value. Conferences of curators seem to be regarded as desirable by several of the writers. Periodical addresses, or short lectures,

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by the curator and others, are also advocated. There is no doubt that wherever these popular discourses have been tried they have led to an increased interest in the collections. The emphasising of the economic aspect of Museums, as instanced by the exhibition of silks with silk-worms, of furs with fur-bearing animals, is one of the points upon which Mr. J. J. Ogle, of the Bootle Museum, lays stress. Mr. Jones, of the Welshpool Museum, is evidently a Radical amongst curators. He would have all treasure-trove deposited in local public Museums, and would urge private collectors to yield their collections to public Museums, where they can be inspected by all, instead of being content with looking at them in their private repositories. We question very much the wisdom of this. As a rule, the most valuable private collections do, some time or other, become the property of the public either by gift or purchase, and in the meantime the owner has facilities (which are in the majority of cases made good use of) for studying the specimens, and perchance working up obscure or unknown facts in connection with them, which neither he nor anyone else could have if the collection were not at his own disposal. The opportunities for working at specimens arranged in cases in a Museum are not to be compared with those existing in private hands.

In addition to the chapters containing tersely-written and generally accurate descriptions of the chief Museums of the country, other chapters are added on special topics. The burning question of "Sunday opening" is the subject of one of these; and, whilst advocating that Museums should be open on Sunday, the author considers that a *plébiscite* of the citizens should be taken in every town, to ascertain fully and fairly the views of those who really own these institutions. Not only are British Galleries and Museums treated of in this volume, but useful lessons are drawn from the management of State Museums on the Continent and in America. The principal institutions in Germany, France, Belgium, Holland, and Italy are briefly described, and their principal features detailed. Notes on Museum management, statistical tables, and appendices complete the work, which, it will be seen, is certainly comprehensive. Some excellent illustrations are introduced. In a work of this kind there will doubtless be found some omissions and imperfections. These, however, are unimportant, and may be set right in a future edition. As it stands, the work is the best handbook to the Museums of our country at present extant in a complete form.

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Musical Sand. By Cecil Carus-Wilson, F.G.S. [Poole. 1888.]

This paper was read originally before the Bournemouth Society of Natural Science. The subject has lately aroused considerable attention In 1350, when Hugh Miller discovered musical sand in the Isle of Eigg, only two localities of its occurrence were known, but since that time it has been found in no fewer than 74 localities. The most "musical" of the sands in the British Islands is that of Eigg, but at Studland Bay, near Bournemouth, the author has discovered another type of this singular phenomenon. A dry layer of sand only four inches in thickness rested upon a wet substratum; it gave out loud sounds when moved, or when a quantity was allowed to fall from a height. The coarsest grains emitted the deepest notes. The author enters into many details respecting the occurrence of this sand, and the supposed cause of the production of the "music," which is attributed to the rubbing together of surfaces of perfectly clean grains of quartz, free from angularities, roughness, or coherent matter clinging to the grains. These microlithic emissions of sound, though individually inaudible, in combination produce a note sufficiently powerful as to be sensible to us. The subject is highly interesting, and deserving of fuller investigation.

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The Volcanoes of the Two Sicilies. By Tempest Anderson, M.D., B.Sc.

In May and June of this year the author of this interesting pamphlet had the opportunity of visiting the volcanic region of the former kingdom of the two Sicilies, and took photographs of the craters, lava-streams, and other phenomena around Vesuvius, Etna, Stromboli, and Vulcano, with a view to obtain materials for a comparison in case of subsequent eruptions. Since Dr. Anderson's visit an eruption has occurred in the neighbourhood of Vulcano, in the Lipari Islands, and his observations and photographs are thus rendered of great value. Many of the places described and pictorially depicted by the learned doctor are now destroyed, including the residence of Dr. Narlian, whose graphic account of the late eruption and its effects as experienced by himself, excited the greatest interest throughout the country when it was published a couple of months ago. Dr. Anderson's visit formed the subject of a joint communication by himself and Dr. Johnston-Lavis, of Naples, at the Bath meeting of the British Association, on which occasion his fine series of photographic views was exhibited in Section C. The morning devoted to the discussion on Vulcanology, opened by Dr. Anderson's paper, was one of the most profitable of the meeting. It may be mentioned that copies of the photographs referred to may now be obtained from Mr. A. Pumphrey, of Birmingham. Many of these views are quite unique, and the untouched negatives showing small volcanic eruptions, and the interior of craters, &c., give a far more realistic impression of such phenomena than is usually to be obtained.

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"The Writer" is the title of a new monthly journal for literary workers. It is well printed on good paper, and contains much that will be of practical utility to those for whom it is specially designed. An article on the "Best Fifty Books for a Young Journalist" is decidedly "smart." We are told that the journalistic aspirant "does not require to know much about trigonometry, the conic sections, differential calculus, astronomy (beyond what he can get in the Book of Job), botany, geology, physiology, entomology, navigation, architecture, electricity, horticulture, agriculture, or meteorology. A very small modicum of any of these goes a long way towards unfitting him for the profession." Noting such opinions as these, we cannot wonder at the miserable "hash" which some newspapers serve up as reports of scientific matters.

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The Journal of Microscopy and Natural Science for January (Bailliere, Tindale & Cox) contains the Address to the Postal Microscopical Society by its new president, Mr. Edwin Bostock, F.R.M.A., several interesting articles, and many useful notes and reviews. This journal, which is edited by Mr. Alfred Allen, of Bath, is undoubtedly of very great value to the microscopist and student of natural science.

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Some Recent Contributions to the Theory of Evolution. By Professor W. A. Herdman, D.Sc., F.L.S.

[From "Proceedings," Liverpool Biological Society, vol. iii.]

The inaugural address by Dr. Herdman to the members of the Liverpool Biological Society deals with recent additions to and modifications of Darwin's original theory of evolution. Some of the more advanced evolutionists go even further than Darwin himself in their belief in the all-powerful action of "natural selection," and others, including Dr. Romanes, urge the claims of other factors upon the attention of biologists. Dr. Herdman contends that the principal objections of Dr. Romanes can be overcome; that intercrossing with parent forms need not always swamp useful variations, and that natural selection is more than a theory of adaptations, as Dr. Romanes insists, but also a theory of the origin of species as Darwin believed. In support of these contentions, he cites several observations of his own, especially amongst the Tunicati. The great difficulty of the "intercrossing" theory, originally pointed out by Fleeming Jenkin, is valiantly met by Dr. Herdman, who shows that the influence of atavatism, or reversion to ancestral characters, had been ignored in the discussion. An instance, indeed, had been given by Darwin of a single variation in a flock of sheep giving rise to a new and most marked race. Even more interesting to general biological students are the author's remarks on the bearing of acquired characters upon the theory of heredity. Here, a boundless field stretches before the biologist. Dr. Herdman wisely considers that what most seriously demands our attention at present is practical work and experiment bearing upon evolutionary problems, supporting and controlling our speculations, carried on not only in the study and the laboratory, but in the field and on the sea shore. The protective colours and habits of movement in animals is another subject touched upon by Dr. Herdman, and some remarkable instances of protective mimicry, as noticed amongst the amphipods and turbellarian worms, are quoted in the course of his very instructive and suggestive address,

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A Text-book of Elementary Biology. By R. J. Harvey Gibson, M.A.
[Longmans and Co., London.]

THE author of this work is lecturer in botany at University College, Liverpool. The book is a volume of some 360 pages, well printed in fairly large type, and by the free use of thick lettering many of the more important technicalities and definitions are emphasised. For text-books this feature is decidedly useful. Many of the well-known scientific manuals and text-books have been laid under heavy obligation for illustrations. Of the 192 illustrations used in the work, upwards of 170 have been copied, and many of them have special reference to human anatomy and histology, and their utility for use here might well be questioned. Further, after the very excellent original illustrations recently published of types usually taken by students of biology, we fail to see that the apology of the author on this point will be at all acceptable to the class catered for. We advise the beginner in the study of biological science to omit Chapter I, with its summaries of the principal conclusions of the inorganic sciences. The attempt is altogether too ambitious on the part of the author. Physics and chemistry can no more be taught to students in this way than biology can be imparted to students of physics and chemistry by a *few pages of principal conclusions* written at the beginning of a text-book on these subjects. If students are familiar with chemistry and physics then the earlier chapters of the book under review will be of no avail; if they are not—and our author in his introduction refers to the "absurdity of endeavouring to grapple with the principles of biology without a preliminary acquaintance with the facts and laws of physics and chemistry"—then we think this short dissertation will prove a snare and a delusion.

Notwithstanding the apology in the "Preface," it does appear to us altogether beside the mark, in a work on *Elementary* Biology, to be frequently discussing subjects which are almost purely hypothetical The object of such a work should be to give, in clear, well-defined terms, information on well ascertained facts concerning the biology of carefully-selected types, and instructions as to the best means of procuring, preparing, and manipulating the subjects in order to become *practically* acquainted with the fundamental facts of morphology and physiology. We must regard it as a serious misconception of the actual want of students to occupy so much of an elementary book with theories and speculations which must inevitably disturb the mind and burden the memory of the reader to the exclusion of that sound instruction which will set the students upon a firm foundation of biological fact.

For another reason we regret that the author has felt himself called upon to occupy so much of this work with speculation, however useful and interesting to specialists. Parrot-like, on every side we hear these theories repeated; endless talk on Protoplasm, Protomyxa, Protamœba, and so on, and in a mass of learned, loud-sounding words much ignorance is covered, and the most complete apology for laziness suffered to go current. We cannot pass, without citation and criticism, some theories on pages 60 and 61. Speaking of the *encysted* state of Protomyxa, the *cyst* is accounted for by being regarded as formed from the *excreta* of the resting organism—because during this condition the rapid escape of effete matter would be impossible. "The fact that the cyst is at first wanting, then thin, and gradually becomes thicker, is thus explained." This is a profound deduction; on the same lines of reasoning we suppose we must account for the formation of the *cell-wall* in vegetable cells. For we are told by the author that the nature of this cyst in *Protomyxa* is cellulose. Cellulose, again we are carefully reminded, is composed of carbon, hydrogen, and oxygen. True; but is there nothing else represented in the excreta of *Protomyxa*? How is the nitrogenous excreta accounted for?

The fondness of the author for generalisations, and his fascination for multiform terminology is strikingly prominent. We are also impressed with the fact that there is an almost total absence of reference to the function of the microscope in elementary biology, probably it was thought that the ample supply of pictures does away with the necessity for the student seeing and investigating for himself. The types of animals and plants selected differ in many respects from those usually found in the best text-books on biology, and we do not see that those selected meet the case of any particular class of students. The last chapter of the book gives a brief account of the "History of Biology," which doubtless will be useful to some readers. On the whole, we fail to see that the book compares favourably with the decidedly practical works that are already within reach of the student, and, on the other hand, many of the subjects dealt with might well have been left for more advanced books.

Museum Notes.

EVENING OPENING OF THE LIVERPOOL MUSEUM.—The statistics for the first eleven nights when this Museum has been open to the public have now appeared, from which we gather that the average attendance of visitors was 345, and that the cost of gas, attendance, &c., amounted to £30 4s. 8d, being an average of £2 14s. 11d. per night. The Museum was open once a week, on Monday evenings only, from 7 until 10 o'clock. Popular lectures have been given on each occasion, usually lasting half-an-hour, and these have formed a great attraction. The Library Committee passed a resolution recommending that the evening opening of the Museum on Mondays be continued until the end of March. A vote of thanks was accorded to the lecturers who had given their services.

SHEFFIELD MUSEUM.—A pair of Pallas's Sand Grouse, killed at Market Weighton, Yorkshire, in June last, have been presented to this Museum.

MANCHESTER MUSEUM.—Professor A. W. Williamson has commenced a short course of three lectures, given on Saturday afternoons in the Owens College, the subject being "The Vegetation of the Earth during the Primary, Secondary, and Tertiary Periods." Each lecture is followed by a demonstration in the Museum. An oil portrait of Professor Williamson has lately been presented to the college by old and present students, on the occasion of the professor's retirement from his duties in connection with the University College. The presentation was made by Sir Henry E. Roscoe.

UNDER the will of the late Mr. Arthur Ditchfield, a valuable collection of his oil and water-colour paintings, by eminent artists, has been bequeathed to the trustees of the National Collection at South Kensington. In addition to this, another collection of etchings and lithographs by French artists falls to the lot of the British Museum.

THE evening opening of the British Museum will probably lead to the introduction of the electric light, which is a far more pleasant, besides being a safer, mode of illumination for Museums.

SOUTH KENSINGTON AND BETHNAL GREEN MUSEUMS.—There has been a very marked increase in the number of visitors to the South Kensington Museum during the last year, the numbers rising from 788,412 in 1887 to 896,225 in 1888. But the increase of 108,813 is quite put in the shade by that of 500,582 at the Bethnal Green Museum, which in its total of 910,511 for the past year, has, as will be seen, distanced the parent institution. This great influx of visitors, more than double that of the previous year, is attributed in great measure to the exhibition there of Her Majesty's jubilee presents after they had been shown to the West-end at St. James's Palace. But some part of the increase must be attributed to the fine collection lent by the Hon. W. F. B. Massey Mainwaring. The increase in numbers at South Kensington was not confined to the main Museum, but extended to the separate collections—the Science Museum and the India Museum—which are in the galleries at the west side of Prince's Gate, and which are not open in the evenings as are, on three evenings in the week, the collections in the main building on the east of Prince's Gate, and the Bethnal Green Museum. The numbers visiting the science collections increased from 177,465 in 1887 to 251,796 in 1888, notwithstanding the fact that the galleries have been severed by the new road cut across the Horticultural Gardens, while the visitors to the India Museum increased from 116,574 to 152,911. The number of visitors are taken in all cases by turnstiles.—*Journal of Society of Arts.*

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Societies.

Geological Society of London.—At a meeting on 19th Dec. Mr. F. A. Bather read a paper on a new genus of Crinoidea from Bavaria, and Dr. G. J. Hinde followed with another palæontological paper on *Archæocyathus* and allied genera from the Cambrian strata, in which he described some interesting forms of siliceous sponges, in the study of which he is a specialist. Dr. Andrew Dunlop afterwards gave an account of the Jersey Brick Clay, which he regarded as a fluviatile deposit laid down towards the close of the glacial period when the Channel Isles were at a lower level and united to the mainland. The clay occurs in patches covering all kinds of rocks, and is spread over raised beaches. Part of it might be the result of the decomposition of shale, felspathic porphyry, &c., a process still going on in some places. In the course of the discussion which followed, the Rev. E. Hill stated that an analagous clay existed in Guernsey, where it was clearly the result of decomposition of gneiss *in situ*, and referred to the great age of the land surfaces of the Channel Islands.——On 9th January Prof. J. W. Judd, F.G.S., read two communications, both of great interest. 1. *On the Growth of Crystals in Igneous Rocks after their Consolidation*, in which the author gave some additional evidence that the characteristic structures of "granophyric" rock were not acquired by them during the act of consolidation, but resulted from secondary changes taking place subsequently. 2. *The Tertiary Volcanoes of the Western Isles of Scotland.* In the course of a long and elaborate paper (which excited some considerable discussion) the author reviewed a recently published memoir by Dr. A. Geikie on "The History of Volcanic Action during the Tertiary period in the British Island," in which Dr. Geikie adopts certain of Professor Judd's conclusions whilst rejecting others. The origin of the great plateaux of Basaltic lava is referred by Dr. Geikie to "fissure eruptions," supported by facts noticed in the Snake-River country, in North America. This explanation is no longer accepted by several American geologists, and, the author maintained, cannot be applied to the Tertiary Volcanoes of Scotland, where the dykes do not occur in such numbers as would warrant the inference that they formed the conduits through which the lava was erupted. The absence of all proofs of contact metamorphism at their sides and of evidence that the majority of them ever reached the surface at all was commented upon. From recent researches by Professor J. D. Dana in the Sandwich Islands, which have thrown much new and important light upon this subject, the theory of "fissure eruption" will be found to be as unnecessary as it is vague. At some volcanic centres, explosive action preponderates, while at others the main result consists in the extrusion of lava currents. The Tertiary Volcanoes of Scotland exhibit evidence of both the effusive and explosive action on the grandest scale.

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Institution of Electrical Engineers.—The first meeting of the Institution of Electrical Engineers was held on 11th January, when Sir William Thomson, president for the ensuing year, delivered his inaugural address on the subject of "Ether, Electricity, and Ponderable Matter." He began by reminding his audience that when, 14 years ago, the then three-year-old Society of Telegraph Engineers had appointed him its president, it numbered 570 members; now it numbered 1,550. It was gratifying to think how successful had been that young society, founded mainly by Sir William Siemens; though it was to be regretted that many of the old members had passed away. There were, among those who had gone, the first two presidents, Mr. Frank Scudamore and Sir William Siemens, and after them Sir Charles Bright, Mr. Walker, and Colonel Shanklin. To the vigour and energy of Sir Charles Bright, it must be remembered, had been due the temporarily successful Atlantic cable of 1858, and the great consequences which had resulted from it. The Society of Telegraph Engineers had grown not only in membership, but in the extent of its province; and the more representative name of the Institution of Electrical Engineers had now been adopted. At the origin of the society, telegraphy and electro-metallurgy had been the only two practical branches of science to which electricity was applied; but since then a vast augmentation of the field had taken place. There was the electric transmission of power; electric haulage; the application of electricity to naval and military purposes, to electric lighting, and to many other purposes. The province of an electric engineer necessarily touched on that of a civil engineer. Indeed, electric engineers must first be civil engineers. Young people with a taste for electric machines looked upon electric engineering as involving nothing but ether and electricity; it was necessary constantly to be insisting on the fact that ponderable matter had also to be dealt with. The electrical engineer ought to learn mathematics and dynamics after the elements of a good general education. Then he should know a good deal of chemistry and of mechanical and civil engineering and electricity besides. It might be said that the juvenile life was too short for this; but this was not the case. If the other subjects were studied, the electricity could be learnt in a few months, though that statement did not contradict the fact that if electric engineering were adopted as a profession the learner would every day become more conscious of the prodigious field of electricity proper which was to be explored. Maxwell had shown the velocity of light to be related to that of electricity in such a way that it was impossible to doubt that the propagation of electric disturbances through space and of light might perhaps be identical. After treating the question of electro-magnetic induction as relating to submarine cables, Sir William Thomson went on to speak of the efficacy of iron and copper as telephone conductors. Information given by Mr. Bennett, the engineer of the National Telephone Company in Scotland, left no doubt whatever, he said, that there was very considerably less clearness in speaking through an iron wire than in speaking through a copper wire of the same resistance. Mr. Heavyside's investigations on the subject, and Lord Rayleigh's special investigations on the susceptibility of iron to very small differences of magnetic force, put the matter in a very hopeful position, and before many months an absolutely clear understanding might be arrived at on telephone communication through iron wires as compared with communications through copper wires. He had himself calculated out the following figures for the problem of alternate currents through copper wire. Taking the simple case of two parallel copper wires, the distance between which was a large multiple of the diameter of each, the distribution of the currents depended simply on the frequency. Taking 80 periods per second as the frequency, with copper wire of two centimèters diameter the ohmic resistance was eight per cent. more for the alternating current than for the steady current; with a copper wire of four centimèters diameter the ohmic resistance was 63 per cent. more than for steady currents; with a copper wire of ten centimèters diameter, the ohmic resistance was four times what it would be for a steady current. From about ten centimèters diameter upwards, the ohmic conductance—*i.e.*, the reciprocal of the ohmic resistance—increased simply in proportion to circumference, and not to the square of the diameter, as it did for steady currents The ohmic resistance was in simple proportion to the circumference when the conduction was in the ratio of 79 to 70; 79 corresponding to ten centimèters diameter, and 70 to an infinitely greater diameter. With a quadrupled frequency the same figures applied to wires of half the diameter. In concluding his address, which lasted nearly two hours, Sir William Thomson said that the difficulties in the way of forming anything like a comprehensive explanation of electrical phenomena were so great that not even a finger-post pointing to an explanation could at present be imagined. Within the century, however, the whole thing would probably be made as easy to understand as the simplest mechanical law; the scales would

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fall from their eyes. But for the present he must apologize for having to come to the lame and impotent conclusion that really nothing was known of the grand subject that constituted the provin e of electrical engineers.

ROYAL INSTITUTION OF LONDON.—During the Christmas holidays a series of lectures on "Clouds and Cloudland" has been delivered in the theatre of the Royal Institution, Albemarle Street, by Professor Dewar, assisted by Mr. Lennox and Mr. Heath. The lecturer gave a brief outline of the researches made by Howard, and illustrated that scientist's discoveries by means of the electric lantern. He showed that the higher the clouds the less moisture they contained, the temperature above a given altitude precluding the possibility of water existing in a vaporous condition. Some experiments with air of various degrees of purity were extremely interesting. By means of an electric ray equivalent to a sunbeam, Professor Dewar showed the motes floating in the atmosphere, and explained the manner in which, by the process of combustion, these particles could be entirely eliminated. When the air had been suddenly expanded by the process of exhaustion the tube was seen to be covered with minute drops of water. The method of purifying and saturating the air through the agency of a series of vessels—filled with cotton wool and water were shown, and the tube was next filled with impure air, which was again expanded, when the cloud was found to have assumed an entirely different character—namely, that of a dense fog. The action of an electric spark and the heat from a platinum spiral were also found to produce a fog—another indication of impurity in the atmosphere. Next, a vessel containing cotton wool was placed between the heated platinum and the tube, and the large deposit of vapour indicated that by this means the atmosphere had been thoroughly purified. Amongst other interesting experiments shown was that of the condensation of vapour when warm by bringing it into contact with cold gas, and also that of the formation of needlelike ice-crystals around a tube through which a current of cold gas was passing. Illustrating the theory of radiation, Professor Dewar showed how, by means of focussed mirrors and a red-hot ball, sufficient heat could be generated to ignite paper, even at a distance of six feet, and he also exhibited the radiating power of various bright and dark surfaces.

ROYAL GEOGRAPHICAL SOCIETY.—On 7th January Mr. F. S. Arnot read a paper descriptive of a journey from Natal to Bihè and Benguela, and thence across the central plateau of Africa to the sources of the Zambesi and Congo. He said that, instead of following Commander Cameron's route, which lay along the north bank of the Lumese, he kept more to the south, and followed for some days the north bank of the Luena river. The Vachibokwe people with whom he came in contact were remarkable for their activity and industry. Their wild, independent ways were a constant source of anxiety to him, but he suffered no injustice at their hands. These people were the first to discover a method of extracting rubber from the "Talamba" root, which had led to a great improvement in trade at Benguela and other parts; and this showed that these Africans were not altogether incapable of utilising the resources of their own country without the help of Europeans. Large quantities of bees'-wax also were procured by them for purposes of trade. The object of his (Mr. Arnot's) going to Africa was to establish a station in a healthy part of the interior, which he accomplished after seven years. Although he travelled without a white or even a black companion, and with no body guard or show of arms, he never received any ill-treatment.

CITY OF LONDON COLLEGE SCIENCE SOCIETY.—On Friday, the 4th ult., Mr. Frederick Davis read a paper before this society on "Recent Advances in the Chemistry of the Alkaloids;" in the course of which he spoke upon cocaine, and the hitherto debateable point respecting the presence of a second alkaloid in coça leaves, and stated that according to Prof. Leibermann a second alkaloid really did exist to which the name of Isatropylcocaine had been given. In concluding his notes upon cocaine he said that within the past month cocaine had been prepared synthetically. Further remarks dealt with the character of other vegetable alkaloids, and closed with notes on several animal alkaloids and organisms connected with typhus fever and other diseases. A very fine collection of alkaloids supplied by Messrs. Burroughs, Wellcome and Co., of Snow Hill, and Messrs. Hopkin, Williams, of Hatton Garden, was shown. On Tuesday, Feb. 5th, at 7 p.m., Mr. W. Symons, will read a paper before the society on "The Igneous Rocks of Cornwall."

NATURAL HISTORY SOCIETY OF GLASGOW.—The fourth meeting of the session was held in the Society's rooms, 207, Bath Street, on Thursday, 27th December, Mr. Thomas King, vice-president, in the chair. Mr. R. Broom, B.Sc., exhibited a preparation of the windpipe of the emu, illustrating the peculiar tracheal cavity of that bird. Situated about the middle of the lower half of the trachea is an opening formed by a defect in eight or ten of the rings, and leading into a pouch which lies on the front of the windpipe. This remarkable structure is only known to exist in the emu, and its use does not seem to have yet been satisfactorily ascertained. Professor W. C. McIntosh, M.D., LL.D., F.R.S., St. Andrews, sent for exhibition a specimen of *Leonuria vitrea*, a stenophore new to Britain, obtained last May in St. Andrew's Bay. Dr. Francis P. Flemyng, Pau, France, exhibited and presented to the Society an herbarium of plants illustrating the flora of the Pyrenees. Mr. William Stewart showed specimens of *Peziza domestica*, a fungus apparently unrecorded for Scotland, and stated that the plant, which grows on damp wall-paper in houses, consists of minute red cups closely aggregated on a whitish mycelium. It appears to have occurred for several successive seasons in houses in one of the southern suburbs of Glasgow. Numerous other specimens of fungi from various districts in the west of Scotland were exhibited by Messrs. W. Stewart, T. King, and D. A. Boyd. Mr. C. Sherry showed specimens of *Alethopteris lonchitica* and *Neuropteris dilatata*, two fossil ferns from the neighbourhood of Dundee. Mr. J. J. F. X. King exhibited a theodolite having two of the quadrants partially covered with a web of extremely delicate texture, apparently spun by a species of *Psocus*, one of the neuroptera, which had in some way obtained access to the instrument. The following papers were read:—"Note on the Occurrence of *Radula voluta* in Ayrshire," by Mr. James McAndrew; "Revision of the Scotch *Perisporiaceæ*," by Professor J. W. H. Trail, M.D., F.R.S.E., F.L.S.—The third of a course of biological lectures under the auspices of the Society was delivered on Tuesday, 8th January, by Professor W. A. Herdman, D.Sc., F.R.S.E., F.L.S., University College, Liverpool, the subject being "The Life-History of an Ascidian." After describing the haunts, appearance, habits, and structure of typical examples of these animals, he gave an interesting account of their development, and referred to the apparent affinity between their free-swimming larvæ and certain vertebrate animals—notably fishes of the genus *Amphioxus*, and the tadpoles of frogs—in the possession of a noto-chord or rudimentary back-bone. It was evident that the ascidians were at one time free-swimming chordata, allied to the lowest types of fishes, but that they had reached their present position by a process of retrograde development or degradation. The lecture was illustrated with lime-light views. Sir John Neilson Cuthbertson, chairman of the Glasgow School Board, presided.

LEEDS GEOLOGICAL ASSOCIATION.—At the December meeting of this association, Mr. Hardcastle had been announced to give a paper upon his favourite resort, Ingleton, but as that gentleman has been seriously ill for some time, it was impossible for him to fulfil his engagement. Mr. Holgate, F.G.S., kindly undertook, however, to

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give the members the benefit of the observations he made on a visit to Keswick. His paper was illustrated fully by a large number of specimens of the varied rocks of that district. Mr. Holgate said—If we were desirous of knowing something about the general geology of a district which we had not visited, but which was the drainage ground of a river within our reach, perhaps the readiest way to proceed would be to examine the water-worn pebbles of the river bed or upon its banks. By this course we could form a pretty fair idea of the geology of the uplands from which the river took its rise. Of course, if the river cut through glacial drift, this rule would not answer, still the drift would show the course of the glacier as it swept over hill and down dale carrying with it fragments of any rock which impeded its course. In Yorkshire the vale of Mowbray is a particularly favourable locality for work of this nature, likewise the lower reaches of the Tees, say from above Croft to Stockton. The river has cut its way through a level terrace of till some 50 or 60 feet thick, so that we may stand on this terrace and have a good prospect, the view being blocked by still higher terraces. From this clay or till were extracted a large number of specimens which were exhibited, including coal measure fossils, ironstone nodules, Yoredale and mountain limestone, containing rhynchonellæ, terebratulæ, producti, corals, &c., chert, Shap Fell granite, and a number of other rocks. The latter at the time could not be identified, until upon a visit to the neighbourhood of Keswick the same rocks exactly were seen *in situ*. It was from here that the rocks scattered through the boulder clay of Teesdale had been derived. The first visit was to Castlerigg, or Castle Hill, of Keswick. On the side nearest Derwentwater it is covered with vegetation, but a quarry at the back showed that it was a mass of intrusive basalt, really the neck of an ancient volcano, which once rivalled, if not actually surpassed Etna in magnitude. The rocks deposited in the present area of the Lake District during the period coming between that of the Skiddaw slates and that of the upper silarian are almost exclusively of volcanic origin—they may represent a thickness of from 12,000 to 15,000 feet. At the base of the volcanic series only are there intermixtures with rocks of an ordinary sedimentary character. This would be strong proof that the great Cumbrian volcano or volcanoes were mainly subærial; we could hardly expect that such an immense thickness of rock could accumulate under water without some sedimentary strata intervening, and some traces of the fossil life of the period being found. Mr. Holgate also spoke at some length upon the metamorphism of many of these rocks. Thus rocks, both crystalline and sedimentary, have assumed a schistose character. The metamorphism of the Lake District rocks increases as the granite centres or volcanic foci are approached. Mr. Holgate showed a splendid series of specimens to illustrate this. Thus the Skiddaw slate (sedimentary) was seen passing gradually into a chiastolite slate, next into a spotted schist with incipient crystals of andalusite, again into a mica schist. In the Glendeterra Pass, between Skiddaw and Saddleback, was noted a huge boss of granite, showing a fine instance of contact metamorphism. Mr. Holgate likewise explained the phenomena of cleavage in the Cumbrian slates, and a discussion followed, joined in by Messrs. James Bedford, Harris, B. Pheasey, and Nunns.

THE SOCIETY OF CHEMICAL INDUSTRY.—A NEW ALKALI PROCESS.—A paper was read at the meeting of the Liverpool section of the above society, on the 9th ult., by Mr. E. W. Parnell, F.C.S., on the Parnell and Simpson alkali and sulphur process, which is a method of manufacturing alkali and sulphur simultaneously from common salt and Leblanc alkali waste. Most of us are familiar with the huge mounds of unsightly and unsavoury refuse which surround the alkali districts of St. Helens and Widnes. This refuse consists largely of lime and sulphur, but hitherto only a portion of one of these constituents has been recovered in a merchantable form, and that only after an expensive and laborious treatment. In the Parnell and Simpson process this refuse is simply employed as a substitute for lime in an ammonia alkali process exactly corresponding with the ordinary ammonia alkali process as now worked on an extensive scale in Cheshire and other places. Briefly outlined, the ordinary process is as follows:—Ammonium chloride solution is distilled in a vertical continuous still with milk of lime. The free ammonia evolved is collected in brine. The ammoniated brine thus produced is subjected to the action of carbonic acid gas, in suitable vessels termed the carbonators, limekiln gas for this purpose being forced through the solution by means of powerful pumping engines. By the action of the carbonic acid, sodium bicarbonate is precipitated, while ammonium chloride is formed and remains in solution. The mixture is run on to filters, the bicarbonate washed with water, and finished into soda ash; while the ammonium chloride solution and washings are employed as before described in the distilling operation. In the Parnell and Simpson process, Leblanc alkali waste is employed in the distillation of the ammonium chloride, when in place of ammonia, ammonium sulphide is evolved and collected in brine. The solution thus obtained of salt and ammonium sulphide is carbonated by means of limekiln gas, when sodium bicarbonate is precipitated exactly as in the ordinary process, with formation of ammonium chloride, and is treated and finished in the same way. The sulphur, however, that the solution contained is evolved with the waste gases from the carbonating operation in the form of sulphuretted hydrogen, and is capable of being manufactured into either sulphur or sulphuric acid. The working cost of the process closely corresponds to that of the ordinary process, and as it has an advantage over the latter of an entire saving of the lime employed in the distilling, and also the production, at no extra cost, of sulphuretted hydrogen, the value of the process should be very considerable. It is one in which the chemical decompositions are of a comparatively simple character, and the apparatus now used is by no means very complicate; and the results lately achieved seem decidedly to promise complete success as a remunerative manufacturing operation.

LIVERPOOL MICROSCOPICAL SOCIETY.—The annual meeting was held on the 18th of January, at the Royal Institution, Liverpool, the retiring president, Mr. A. Norman Tate, F.I.C., F.R.M.S., in the chair. The annual report stated that there were now 124 ordinary members, eight honorary members, and one associate; that the meetings had been well attended, and that with the view of still further increasing the usefulness of the society referees had lately been appointed in several departments of microscopical science. A vote of thanks to the retiring officers and council was then passed, and officers and council appointed for the current year, after which the president elect, Mr. Isaac C. Thompson, F.L.S., F.R.M.S., took the chair and delivered his inaugural address, taking as his subject "Our Coming of Age," and in the course of his remarks he briefly sketched the history of the society since its formation in 1868, and then went on to speak of developments in microscopical science during the same period. A hearty vote of thanks proposed by Mr. T. C. Ryley, and seconded by Dr. Carter, was passed to Mr. Thompson for his very interesting address. [We hope in our next issue to give an extended report of this address.]

LIVERPOOL GEOLOGICAL SOCIETY.—The fourth evening meeting was held on the 8th January, at the Royal Institution, the president (Mr. H. C. Beasley) in the chair. Amongst the exhibits was a beautiful specimen of ruby silver ("Rose et claire") from the mines of Iquique, South America, lent by Mr. T. Pugh. Mr. F. P. Marrat, of the Liverpool Free Public Museum, read a paper based largely on his study of the fine Austen collection of crinoids recently acquired by the museum, in which he referred to the mode of attachment of these interesting animals, and the light they throw on the conditions under

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which many geological deposits were formed. Mr. A. Timmins, C.E., of Runcorn, read a paper embodying some valuable details of numerous deep borings in the neighbourhood of Liverpool, interesting on account of its bearing upon the water supply from these rocks. The further question of the geological position of certain beds of soft red sandstone and marls occurring beneath the well-known pebble beds received further elucidation from the extensive series of borings which had been taken. Mr. T. Mellard Reade, F.G.S., and Mr. G. H. Morton, F.G.S., added much information on the points raised during the discussion which followed. Mr. J. Lomas, Assoc. N.S.S., contributed a paper on "Some Volcanic Dykes in the Island of Mull," which he had investigated during a recent visit. Owing to the lateness of the hour when the reading of the papers terminated it was impossible to adequately discuss the numerous important points raised by Mr. Lomas, who had illustrated his paper by a number of specimens collected in the field, microscopic slides, and photographs. Mr. Timmins also displayed a large number of maps, sections of strata, trial-borings, and rock specimens, illustrating the subject of his paper on the Triassic and Permian rocks.

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Liverpool Geological Association.—The monthly meeting was held at the Free Library, on January 7th, Mr. T. R. Connell, vice-president, in the chair. The donations announced as added to the library of the association during the past month included some valuable illustrated works presented by Mr. Connell, books and pamphlets from Messrs. R. T. Jones and G. H. Morton, F.G.S., with several exchanges from British and Australian Geological Societies. Dr. Charles Ricketts, F.G.S., exhibited a series of models in clay, illustrating the effect of vertical pressure on plastic strata. A paper on "A Probable Cause of Contortions of Strata" explained the meaning of the modelled structures. It was the author's wish to show that the flexures in rocks may be dependent on irregular pressure, such as that caused by the deposition of layers and heavier particles of sediment on unconsolidated sheets of mud; thus in experiment it was found that when sand was heaped on to layers of clay permeated with water, the clay bands beneath were reduced to films, whilst those just outside the compressed area became thickened and curved into folds. After a discussion, in which Messrs. D. Clague and Butler Davies and the secretary joined, Mr. D. Clague, F.G.S., described some of the instruments commonly used by mineralogists in measuring the angles of crystal faces. To the rough and ready goniometer of Miller he had added certain improvements, with the result of getting more exact readings and having a neater instrument. Demonstrations on the various forms referred to served to make the value of each readily understood.

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Liverpool Biological Society.—At the January meeting of this society Mr. Harvey Gibson read a paper entitled "Contributions towards a Philogenetic Classification of Plants: Part I.," in which he dealt with the general principles only, pointing out that in any endeavour to work out the philogeny of plants we must first estimate, as nearly as we can, how far the great law of alternations of generations is obeyed, and then, taking both generations into account, examine the degree of differentiation they severally show *(a)* in relation to the conditions of their environment, and *(b)* in relation to their method of producing reproductive elements. The paper was illustrated by a sketch genealogical table, expressing Mr. Gibson's ideas on the general relationship of the chief groups. Details will be dealt with in a future paper. Mr. Gibson also read a short paper on "Embryonic Blastogenesis, or Fission, in Plants and Animals," in which he endeavoured to show that in many groups of plants subdivision of the embryo takes place normally. Professor Caton, M.D., F.R.C.P., read a paper on the variations produced in electric condition of the viscera by stimulation of adjacent cutaneous nerves, in which he showed that if the skin of frog be electrified a current of electricity passes through the intestines. By means of Sir W. Thompson's reflecting galvanometer he was able to demonstrate the passage of the electricity. He used a new form of non-polarizing electrode, made of silver coated with chloride of silver, this being connected with the tissue by means of salt solution. Mr. Isaac C. Thompson, F.L S., F.R M.S, read a report on a collection of tow-net gatherings made by T. C. Ryley, Esq., on the West Coast of Norway, up to the North Cape, during June and July, 1888, in the course of which he said:—

The collection which furnished the material from which this report is drawn up was made by Mr. Ryley during a summer cruise of the steam yacht "Argo," belonging to Alfred Holt, Esq., of Liverpool. One of the very fine-meshed tow-nets of the "Challenger" pattern was used, and the material was at once transferred to bottles containing a preservative solution composed of glycerine, water, and alcohol, with boric acid as an antiseptic. Thirteen bottles of material in all were obtained, each bottle being numbered, and corresponding to a note entered at the time, with particulars as to date, time of day, locality, general atmospheric conditions, &c. The entire contents of every bottle were examined by Mr. Thompson under the microscope, the vast proportion of the material being found to consist of copepoda, sixteen species being obtained. The rest was chiefly quantities of the marine cladoceran *evadne nordmanni*, a few amphipoda, schizopoda, cirripedia, various larval crustacea, annelids, appendicularia, medusæ, peridineæ, and fish ova. The tow-net was thrown over upon the "slowing" of the steamer at the various stopping places, and pulled along at or near the surface as specified, for as long a time as the stopping of the engines allowed. The localities at which the tow-net was used were as follows:—Sogne Fiord, Norway; Skate Trommen, Hummerfest; off North Cape, in the bay; Svareholt Sklubb, fifteen miles east of North Cape; Tromsoe, Lodingen, West Fiord, Luffoden Islands; open sea, two miles from shore; twenty-four miles north of Molde, Geiranger Fiord, considerably inland; near entrance to Sogne Fiord. Mr. Thompson went on to remark that the geographical distribution of the various species of copepoda in our colder and warmer seas is very interesting, the former phase being remarkably illustrated by this collection. As we approach the north, number and size appear to compensate for diversity of species. It has been long known that the large and widely-spread pelagic copepod *calanus finmarchicus* forms the chief food of the Greenland whale, and it will be noticed that in some of the localities about the North Cape, at which this collection was made, this species forms almost the entire mass in the tow-net. Its profusion here enables us to clear up a most interesting question. It has been often remarked that in this, as in some other species of copepoda, the precise manner of ovi-position is mysterious, in as much as females with ovisacs have never been noticed though carefully looked for. Their absence has recently led an eminent naturalist to throw out the theory that *calanus finmarchicus* may be only the larval form of another species, the *euchæta norvegica*, which is usually found only at great depths. In a former paper Mr. Thompson had suggested as possible that *calanus finmarchicus* casts its ova directly into the sea just as fishes do, and its profusion in these northern localities has furnished the opportunity of establishing what seems to be a clear proof of the truth of this theory. For on examining many hundreds of them together, he found small quantities of specially granular ova scattered about, and in two instances appeared as if just ejected from the animal, but entangled by the swimming feet as it met its doom. It is confirmatory of these being the ova of *calanus* that they appear only in such other gatherings as contain in great abundance this species, and of it almost exclusively. Mr. Thompson, in expressing his thanks and those of the society to Mr. Ryley, for furnishing this interesting and valuable collection, remarked that if others who may have the advantage of yachting, or other sea voyages, would take charge of a tow-net to use as occasion allows, they would find an additional zest imparted to their pleasures, and sometimes, possibly, a relief to monotony, and might be largely instrumental in adding to the scientific knowledge of our marine surface fauna.

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Liverpool Science Students' Association.—The monthly meeting was held at the Royal Institution, on December 21st, Mr. W. D. H. Deane, M.A., vice-president, in the chair. An interesting communication was made by Mr. J. Mackarell, concerning the reappearance of the Bedstraw Hawk Moth (*Deilephila Galii*) in the Liverpool district after an absence of eighteen years. A somewhat rare form of fresh water algæ (*Cylindrospermum macrospermum*) was described by Mr. William Narramore. A paper on "The Permian Conglomerate and other Paleozoic Rocks to the north of Morecambe Bay," was read by Mr. J. J. Fitzpatrick. Attention was called to the physical features of the district, to the many varieties of stratafied rocks, also to the chemical constituents of the brecciated conglomerate. Maps, drawings, and specimens were used to illustrate the paper,

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which was of an exceedingly interesting character. —On January 17th a *conversazione* in connection with this association was held in the Royal Institution, at which there was a large attendance. The exhibits included a group of Pallas's three-toed sand grouse (*Syrrhaptes paradoxus*), from each of the three incursions into Britain—viz., in 1859, 1863, and 1888; American quahang or wampum clam (*Venus mercenaria*), attempted to be naturalised in the district, from specimens imported by Capt. J. H. Mortimer and Mr. H. D. Brandreth; trap door spiders and their nests, recently discovered in South Africa building on the trunks of oak and Kaffir boom trees, specially procured for the museum, and presented by Mr. F. Taylor, of Rainhill; variegated wood opal from Wady Halfa, Soudan, collected and presented by Brigadier-Surgeon S. Archer, per Mr. Frank Archer. Several members exhibited objects of interest. After a few general remarks from the President (Mr. Osmund W. Jeffs) as to the gratifying increase in the membership since the establishment of the society in 1881, the Rev. H. H. Higgins gave some remarks on insects and their numerical majority in comparison with the whole of the other created things, animal and vegetable. He also called attention to the specimen of wood opal, previously referred to in these columns.—Mr James Hornell afterwards read a paper on "The Skull and its Story," giving a good deal of information as to man's cranial development, as well as that of the various types of the animal kingdom.—The President then gave notes descriptive of "The Volcanoes of Southern Italy," with lime-light illustrations from original negatives taken last summer by Dr. Tempest Anderson, B.Sc. The illustrations included some striking views of Vesuvius with craters in eruption, the lava-buried city of Pompeii, and the ancient Temple of Serapis in Southern Italy, which gave Lyell the text for one of his classical chapters in "The Principles of Geology." Glancing at Etna, and proceeding to the Lipari Islands, this little-known volcanic region was depicted by a number of views of Stromboli and Vulcano, a mountain which is ever in active eruption. The island of Vulcano was the scene of a violent eruption last July, shortly after the photographs exhibited upon the screen were taken. An account of this eruption by an eye-witness, Dr. Narlian, was given. The speaker remarked that in our own country there were still vestiges of ancient volcanic activity not only in the lava beds and basaltic rocks of recent geological epochs, but also in the hot mineral springs which still issue from British strata. The hot springs of Bath were known to the Romans, who built magnificent erections, which are now being disinterred, to the delight of antiquaries. A view of the old Roman baths at Bath was shown. During the evening Mr. Isaac E. George briefly described a series of petrological slides, lent by Mr. A. Norman Tate, F.G.S. Altogether the *conversazione* was a very successful one, and the committee are to be congratulated on their excellent arrangements.

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Manchester Geological Society.—A meeting was held on the 17th Dec., at the rooms of the Literary and Philosophical Society, George St. Mr. Oswald R. Swete read a paper on a new electric safety lamp for miners. The present was the outcome of a lamp exhibited at Wigan in January last, and numerous tests which had been undertaken in connection with it. The electromotive force is four volts, it consists of two cells, containing one positive and negative element and bolted together in each cell. Its weight at present is but five pounds, which can be considerably reduced later on. Its candle-power is that of one standard candle. Burns for twelve hours with one charge from a dynamo machine of five hours. The glow lamp can be placed wherever best suits the requirements of the colliery owner, namely, on top, bottom, or side, or may be detached altogether from the battery, as in the case of a small railway reading lamp, ready to be affixed to the coat or cap. The battery case is made of birch of a peculiar section, occupying as small a space as is possible, exceedingly strong, and rendered water proof and acid proof by a patented process. A novelty in the glass protector covering the incandescent glow lamp is that it consists of toughened or chilled glass of great strength, but when broken, instead of cracking or breaking into large fragments, flies to very small particles; a lever pressing against the inside of this glass cover would thereby instantly fall forward if the cover were broken, and this at once cuts off the electric current before the blow that breaks the cover could have time to reach the incandescent lamp; thus rendering it absolutely impossible for an explosion to take place from contact of a red-hot filament with a mixture of air and fire-damp. This cover is capable of being locked with a lead plug, and the miners can be given to understand that, in the event of some untoward accident they were entombed within the workings, by picking the lead plug with a pocket knife, the light could be saved up until assistance arrived, which is impossible with any existing oil lamp. The lamp can be turned upside down without detriment, and if turned at an angle will not go out like some oil lamps. As to the cost and maintenance, 1,000 lamps at £1 each equals £1,000, and with the necessary machinery the total amount was £1,090. The total amount for maintenance per annum was £564, which is equal to two-pence half-penny per lamp per week, burning twelve hours a day, six days in each week. No oil lamp, candles, or primary battery can compete with this, and the saving effected on maintenance alone will soon pay the extra cost of lamps; but beyond everything it is absolutely safe, and a good light, better than that at present obtained from oil lamps This lamp has now been tested for a period extending over nine months in various collieries in the north of England.

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The Manchester Microscopical Society.—This Society continues to be very active. At a meeting of the Mounting Section on December 20th there were demonstrations in mounting in balsam by Mr. M. L. Sykes, and in accessories of the microscope by Mr. J. L. W. Miles, and also a practical demonstrative course on animal tissues, including bone, muscle, and nerve tissue. At the January meeting of the Mounting Section, Mr. W. Chaffer gave a demonstration on mounting in glycerine jelly, using previously stained vegetable tissues. Mr. Hoyle gave the first of a series of three demonstrations on optics, taking reflection and refraction, and demonstrated, by means of a lantern and suitable apparatus, the whole of the facts, &c., he referred to. The refractive powers of water, alcohol, ether, glycerine, turpentine, and bi-sulphide of carbon were shown, and the correctness of the rule he laid down as to the relationship between the angle of incidence and the angle of refraction he proved by a very simple contrivance, consisting of two wheels mounted on an axis, and a series of pieces of velvet cut to different geometrical patterns. Mr. Hoyle also very graphically and very clearly demonstrated the action of a ray of light when falling upon similar glass bodies. The whole demonstration, which occupied close upon two hours, was to the very last attentively watched by a large body of members. In the Practical Demonstration course, teeth, tongue, salivary glands, and æsophagus were discussed, and, as usual, sections were previously prepared and distributed to the members. On the 26th of January the annual *soirée* was held in the Lecture Hall, Athenæum, when Professor W. Stirling, M.D., D.Sc., of Owens College, delivered a lecture on "Electrical Phenomena in Animals."

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Manchester Scientific Students.—On 12th December Mr. John S. Pollitt read a paper describing the growth of the Photographic Art, in the course of which he said:—"It is hardly necessary in a society such as this, except for the purpose of making my sketch more complete, to call your attention to the fact that there existed in this country during the sixteenth and seventeenth centuries several societies of men who gave themselves the name of alchemists, and whose researches in philosophy, if largely mixed up with superstition, were yet pursued with a zeal and a perseverance, as we now say, worthy of a

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better cause, in the vain hope of discovering a method by which they could transmute the baser metals into gold. To that end they spent their lives and their energies for more than one generation in conducting to an incredible extent experiment after experiment, which, however, neither brought them within reach nor even measureable distance of the object of their pursuit. But the industrious investigations of an inquiring mind, though it may only have a phantom for its object, not infrequently stumbles accross rather than discovers something which, either not understood at all or understood very imperfectly at the time, may afterwards turn out largely to enrich the arts and sciences. In this way these alchemists had come across a substance found in some of the silver mines of Germany, which was really the silver ore impregnated with chlorine, and, having undergone a state of fusion, had a semitransparent appearance. They were greatly puzzled by this discovery and by its tendency to darken rapidly on exposure to sunlight. They noted its peculiarities and called it by the name of horn-silver, on account of its partially transparent appearance. I have it here (chloride of silver); but as it has not undergone fusion the transparency which characterized the original is absent. It is formed by what chemists know as double decomposition between nitrate of silver and chloride of sodium or common salt—the way in which chloride of silver is now produced. This is really the keystone or starting point around which all photographic processes are built. It does not appear, however, that the alchemists were able to turn their discovery to any practical use. In fact, on the principle that Rome was not built in a day, it would have been strange had it been otherwise when both the mechanical and chemical sciences were only in their leading strings." In 1839 a process of great delicacy and beauty was evolved on silver plate, and announced to the world as Daguerreotype. By an accident Daguerre found that a feeble image could be fully brought out by holding the plate over the fumes of heated mercury, and in this way the first idea of developing a latent image was conceived. At this time no satisfactory system of fixing was known, it being left to Sir John Herschell to introduce the use of hydrosulphate of soda, which then became the recognized fixing agent. The Daguerreotype period lasted for about twelve years, but the process was a slow one, and the displacement of almost all hitherto existing processes came about very quickly on the announcement by Mr. Frederick Scott Archer, in the summer of 1851, of the discovery of a process on glass, a process which could be made either negative or positive at the will of the operator. Now, by the aid of gelatino-bromide, all the world had become photographers. Some beautiful pictures were produced by the platino-type process. Some very fine portraits were also shown, which were taken in 1852 by the Daguerreotype process.

The Medals and Funds to be given at the Anniversary Meeting of the Geological Society of London on February 15th, have been awarded by the Council as follows:—The Wollaston Medal to Prof. T. G. Bonney, D.Sc., F.R.S.; the Murchison Medal to Prof. James Geikie, F.R.S; the Lyell Medal to Prof. W. Boyd Dawkins, F.R.S.; and the Bigsby Medal to Mr. J. J. Harris Teall; the balance of the Wollaston Fund to Mr. A. Smith Woodward, of the British Museum; that of the Murchison Fund to Mr. Grenville A. J. Cole, of the Science Schools, South Kensington; and that of the Lyell Fund to M. L. Dollo, of the Royal Museum at Brussels.

Amongst the recent elections to this Society we note with pleasure the names of the Rev. E. Maule Cole, M.A., of Wetwang, president of the geological section of the Yorkshire Naturalists' Union; S. Chadwick, of Malton, curator of the Malton Museum and joint geological secretary to the Y.N.A., in conjunction with Mr. Adamson; and Dr. F. Fulder Walton, of Hull, president of the recently-formed Hull Geological Society.

Obituary.

The late Mr. J. J. Coleman.

We notice the death at Bearsden, near Glasgow, on the 18th December, of Mr. J. J. Coleman, F.R.S.E., F.I.C., F.C.S., &c. Mr. Coleman was the son of a pharmaceutical chemist, in Lincolnshire, and in his early business life was connected with a similar business in Halifax, but, devoting his leisure time to scientific study, he afterwards became a teacher of science in different educational establishments. Whilst engaged as science tutor in the Training College at Chester, under the Rev. Dr. Rigg, there were established in Flintshire several oil works for distilling oil from cannel, shale, &c., and refining the products, and Mr. Coleman left Chester to erect and manage one of these. A few years afterwards, having in the meantime achieved great success in this manufacture, he was engaged by Young's Paraffin and Mineral Oil Co. to carry out experimental investigations and succeeded in making several valuable discoveries, especially in connection with the uncondensed gases from the shale retorts. In dealing with these he invented a machine for producing low temperature and great pressure by mechanical means, and this brought him into contact with Sir William Thomson, which resulted in a close intimacy between the two, and as a consequence Mr. Coleman was consulted by Mr. James Bell, of Glasgow, the well-known importer of fresh meat from the United States, to devise efficient means for mechanical refrigeration. The problem was soon solved, and about ten years ago the first Bell-Coleman mechanical dry-air refrigerator was fitted up in one of the Anchor Line steamships and proved so successful that the demand for these refrigerators soon became very great. Mr. Coleman was a frequent contributor to the proceedings of scientific societies and occasionally contributed valuable communications to the Philosophical Society of Glasgow, the Institution of Engineers and Shipbuilders in Scotland, the Royal Society of Edinburgh, the British Association, and was Hon. Treasurer and afterwards Chairman of the Glasgow and Scottish Section of the Society of Chemical Industry. A man of great industry, possessing a mind well stored with scientific facts and aided by a facility for using these in a thoroughly practical manner, Mr. Coleman did most excellent work. He died at the age of 50, and his death cannot but be regretted by a large circle of friends who appreciated not only his scientific attainments and work, but also his modest and retiring, but thoroughly liberal and kind-hearted, disposition.

The death is announced of Mrs. Merrifield, well known as a writer on Algæ and kindred subjects. She died on January 4th in her 85th year. In *Nature* for January 10th there is an elaborate article on Algæ recently written by this lady.

The obituary of the year 1888 includes the names of many eminent scientific men, amongst whom we may mention Dr. Alexander Dickson and Professor Asa Gray (botanists); Dr. Boswell, Henry Lee and P. H. Gosse (naturalists); Carvill Lewis, F. W. Hayden, G. R. Waterhouse and W. H. Bailey (geologists); R. A. Proctor (astronomer); T. H. Potts (ornithologist); W. Thompson Watkin (antiquary); Sir C. T. Bright, George Godwin, Bonamy Price, and Leoni Levi.

Answers to Correspondents.

A. W. Richardson.—Your suggestions have been duly noted, and will be acted upon whenever practicable. We think you will see that in our later issues the matter has not been lost sight of.

A Beginner (Doncaster).—(1) You cannot have better guides than Lyell's "Students' Elements," or Geikie's "Class Book of Geology," both of which works are about the price you mention. Davis's "First Book of Geology," published by W. Collins, Sons & Co., at 1/-, and "Geology for All," by J. Logan Lobley (Roper & Drowley), 2/6, are both excellent introductory works, and we should advise you to read these along with Lyell or Geikie. (2) Apply to Mr. S. Henson, of 97, Regent Street, London, who can supply you with specimens.

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NOTICES.

☞ *Notwithstanding that we have this month given four extra pages, we regret that, owing to pressure on our space, we are still compelled to hold over till next month several articles, reviews, &c.*

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & CO. Price 3d., or by post, 4d. Annual Subscription 3s., or by post, 4s.

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Remittances and Communications respecting Advertisements, should be addressed to C. BIRCHALL, 32, Castle Street, Liverpool.

Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Practical Entomology and the Preservation of Agricultural, Fruit, and Garden Crops.

OF the many scientific inquiries that can assist in solving some of the practical questions of the day there is none more interesting in its scientific aspects, nor more serviceable in practical directions, than the study of entomology in relation to the injuries caused to plant-life by the ravages of insects, and the consequent damage to agricultural crops, fruit, and garden produce. For the better preservation of these it is undoubtedly desirable that, amongst other investigations, there should be careful, systematic study of the life-history of insect pests, especially with regard to the manner in which they harbour amongst and attack trees and plants of lower growth.

The value of such investigations is admirably shown in the Second Annual Report to the Lords of the Committee of Council of Agriculture by their Scientific Adviser Mr. Charles Whitehead.* This report deals with insects and fungi injurious to the crops of the farmer, the orchard, and the garden. It records, in a general report, the prevalence during the year of beetles attacking peas and beans, both in field and garden, and the issue of a special leaflet to agriculturists and market gardeners, with descriptions of these insects and their life-histories, and means to be taken to prevent their increase. It also speaks of most serious injuries caused in May and June by caterpillars to apple, pear, plum, damson, filbert, gooseberry, and currant trees in many of the principal fruit-producing districts, and of the distribution of an illustrated circular early in October among fruit growers in the counties of Devon, Gloucester, Hereford, Kent, Somerset, and Worcester, pointing out the habits of certain species of these destructive insects, and recommending prompt action to prevent the wingless female moths from crawling up the fruit trees to deposit eggs upon them in the late autumn and first winter months.

Attacks of a certain species of beetle destructive to cherry trees are also referred to, and there is likewise mention of a beetle that greatly injured wheat plants; and, further, mention is made of injuries to wheat and barley due to the ribbon-footed corn fly, but attributed to the Hessian fly; of

* Published by Eyre & Spottiswoode, London; Adam & Charles Black, Edinburgh; and Hodges, Figgis & Co., Dublin.

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mischief done to oat plants by the larvæ of the tiny "frit fly;" of harm done to grain stored in granaries by another species of beetle; of the destruction amongst hop plants caused by the hop-aphis; and of injuries done by other insect life and by fungi; and the report then goes on to describe several of these pests and their habits, and to show modes of preventing their attack, and remedies.

This is entomology made practically useful, and it is to be hoped that such work may be much extended. Similar work is being done in other countries, and especially in America, where the United States Department of Agriculture is doing really valuable service by its investigations and reports.

We specially commend such work to the attention of entomological societies, for in it there will be found opportunity of making their scientific inquiries practically useful. And it is not only such societies and specialists in agricultural and garden matters who can do service in this direction. There are many amateur scientists interested in entomology whose observations, if systematically pursued and recorded, could aid greatly to our knowledge of the insect pests of plant life, and to these also we would appeal. Records made by any careful observer of the transformations, reproduction, and whole life history of such insects, with notes as to when and how they infest and become injurous to plant-life, the special mischief they cause, the means found most useful in preventing their attacks, or of destroying or removing them, would be of great value to practical agriculture and gardening. We trust that many who are interested in scientific inquiries, but who are at a loss for special subjects for study, may make their studies practically available in the useful directions now indicated.

Radiation from Snow.

By Dr. McPherson, F.R.S.E.

A CENTURY ago the attention of Professor Wilson, of Glasgow, was particularly directed to the matter of temperature during the time of snow, by the very remarkable cold which was experienced during one of the winters. He observed that there was a considerable and unexpected difference of temperature of the snow which covered the fields and that of the air at a few feet above. The snow was the colder; and he correctly guessed that this excess of cold depended upon radiation from snow. At eleven o'clock on the 28th December, 1783, a very clear night, he placed a delicate thermometer upon the surface of the snow near the Observatory, and fixed a second thermometer four feet from the ground, exposed to the free air. The upper thermometer read 5° Fahr., and the lower—7°, making a difference of 12 degrees. In an hour afterwards the sky became overcast, and both instruments registered the same, viz., 7° Fahr. Then the fogginess was dense. He was astonished at the result.

Accordingly, to verify these observations, he made a similar experiment on the night following. There was again a difference of 8 degrees when the sky was clear, but an hour afterwards a dense fog brought the thermometers to the same temperature, viz. 12°. On the night of the 30th, when the sky was overcast, the snow became considerably warmer than the air above. At 10 o'clock p.m. the thermometer on the snow registered—12°, and the one above—4°, showing that the temperature on the surface of the snow was 8 degrees *colder* than the stratum of air four feet above. Two hours afterwards the heavens became cloudy, and the temperature of the snow registered 4°, while that of the air above was down to zero, indicating that in this case the temperature on the surface of the snow was 4 degrees *warmer* than that of the air four feet above it.

Again, the snow three inches below the surface of the snow registered 24°, a difference in one case of 36 degrees for the three inches—a remarkable result. It was, however, left to Mr. Aitken to complete the observations. Had the Professor placed a thermometer's bulb on the surface of the ground underneath the snow, he would in all likelihood have been more astonished, as he would probably have found the temperature of 32° Fahr.—a difference of 44 degrees of heat occasioned by the coating of snow. Had he placed a thermometer below the ground, he would have found it registering a still higher temperature.

Strange is it that a century elapsed before anyone thought of verifying and extending Professor Wilson's observations. Had Dr. Wells done so, he would not have clung so tenaciously to his theory of dew as falling from the atmosphere. Mr. Aitken in Scotland, and Dr. Woeikoff in Russia, have satisfactorily verified the experiments, and also found that snow has a decided cooling effect during the day. On the 19th January, 1886, at 10 a.m., Mr. Aitken found that a thermometer placed on the snow in the shade registered 12°, while an insulated black surface similarly situated had a temperature of 16°, the air at the time being 20°. Thus, when the snow and the black surface were both *colder* than the superincumbent air, the snow was 4 degrees colder than the black surface. But a remarkable result was noticed on the 5th February at the same hour. Then the air was 23°, the black surface 29°, and the snow 25°. In this case, when the snow and the black surface were both *warmer* than the superincumbent air, the snow was 4 degrees colder than the black surface. In the former case the sky was clear; in the latter case it was overcast.

Mr. Aitken was of opinion that the cooling effect of the snow is produced by two causes—radiation and evaporation. The lower temperature of the snow on these occasions was due to its small absorbing power for heat of the kind radiated by the sky; and also, though slightly, to the evaporation from its surface. This small absorbing power of snow must have a decidedly lowering effect upon the temperature of the superincumbent air. Lands covered with snow must have a colder atmosphere than those uncovered; and when a country has been covered with snow for a considerable length of time, there will be a tendency to glacial action.

The experiments of Wilson and Aitken also showed that snow is a very poor conductor of heat. Wilson found that three inches below the surface of snow the thermometer registered a temperature of 36 degrees warmer than on the surface; and Aitken found that when there is a good coating of snow the surface of the ground is never colder than the freezing point. He cooled a thermometer several degrees below the freezing point by placing it in a freezing mixture of salt and snow, and pierced this through the snow coating on to the surface of the ground, and the temperature of the mercury soon rose to the usual freezing point. He was also even more struck with the fact that when the ground was intensely frozen before the snow fell, the internal heat from the earth thawed the surface under the protection of the snow. This protection afforded by the bad conducting power of snow is of vast importance in the economy of nature. When the snow is removed after lying for a considerable time on the ground, the wheat blades are seen in a rich, healthy green; whereas in a black frost, without snow, they are half-blackened and sickly. Snow is actually a warm cloak to the vegetation. Alpine slopes present this beautiful natural protection in a very marked manner.

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On the other hand, though snow protects the plants beneath, it has, in a cloudless sky, a chilling influence upon the air above. The temperature of the atmosphere over snow-clad lands is considerably lowered. This is to a considerable extent due to radiation. Snow receives less heat from the direct rays of the sun than the surface of a black body, and always absorbs but little of the sky radiation. Radiation, then, is, besides the bad conducting power of snow, an important cause of producing the lower temperature of the air while snow is on the ground.

Dr. Woeikoff has devoted the last sixteen years to the study of local climates and their dependence upon local causes, especially in the plains of Russia. According to his report on the cold of 1877, that year was a striking instance of how the absence of snow was accompanied by a far *less* notable lowering of the temperature during the prevalence of anti-cyclones than would have been the case had the soil been covered with snow. There was during that year no snow in Eastern Russia until Christmas. Quite bright weather lasted in December for more than ten days, and in the region which was yet uncovered with snow no great cold was experienced. But in the following March, on the other hand, after three months of continued snow, the surface of the country was much cooled, and exercised a refrigerating influence on the air. This eminent authority then concluded that anywhere, if the snow-covering has been thick, and especially if the snow has a harder consistency by being long on the ground, the genial air of spring-time lags behind. The same conditions have been since noticed by Dr. Billwiller during the winters in West Europe.

What a compensating power in nature! The plants, which in a cold winter would be unable to keep themselves in health, are protected by the snow mantle; whereas animals, which can keep themselves in heat by exercise, do not suffer by the necessary loss of the heat of the earth, which is prevented by the snow-covering from passing through.

A Young Female Gorilla.

To the Editor of "Research."

Sir—I have much pleasure in placing at your disposal, by permission of Mr. R. W. Roulston, agent in Liverpool to the Zoological Society of London, a photograph of a young female gorilla. The specimen belongs to his friend, Mr. J. J. Jones, a trader at Ngove, a station on the West Coast of Africa, about one degree south of the equator, in whose possession it had been living for some time. It has already attained considerable notoriety, a lengthy notice of it having been published in the *Athenæum* of the 12th of January last.

Mr. Jones has trained the little anthropoid to follow him like a dog, and she recently accompanied him on a journey to Sette Camma, a distance of twenty miles or more, walking all the way. Jennie, as the baby gorilla has been named, sleeps in her master's room and follows him wherever he goes, weeping like a child if left behind. She has acquired many civilised tastes and habits, and will drink tea, ale, brandy, &c., out of a cup or glass, displaying the utmost carefulness not to break the vessel, and will, in fact, do almost anything her master wishes, and is so intelligent and affectionate as to greatly astonish and interest all who have seen her.

Mr Jones, in a recent letter to Mr. Roulston, says:—"I am very much pleased to say that Jennie is still keeping in good health. She will do almost everything but talk, and will 'chop' (that is the local term for *eating*) anything, such as salt beef, pickles, jam, bread, fowl, fish, &c. When I was at Sette Camma Mr. Lynslager took our photo, which I send you. While writing this I have had to get up a dozen times to stop her from chopping the pickles and other things on the table. Oh! she is a trouble and funny. She sleeps near me, and won't sleep elsewhere."

If Mr. Jones's success continues we may hope in due time to see Jennie in Liverpool. She will not, however, be the first of her name or species to arrive here. In the winter of 1855-56 Mrs. Wombwell exhibited in Liverpool, at the foot of Shaw's Brow, a young gorilla called Jenny, which lived with her in her own special travelling carriage, about which it jumped and climbed freely. A short notice of this living animal was written by Mr. Waterton, and published in some local paper. This, I believe, to have been the first living example seen in England, or indeed in Europe, as noted by me in the *Annals and Magazine of Natural History*" for Dec., 1862. Upon its death in March, 1856, it was forwarded by Mrs. Wombwell, in gratitude for his notice, to Mr. Waterton, in whose museum at Walton Hall I subsequently saw the preserved skin. The skeleton was forwarded direct from thence to the museum of the Philosophical and Literary Society of Leeds.

The next living gorilla which came under my observation was "Pongo," brought to Liverpool, in June, 1876, by Dr. Falkenstein and his party of German explorers on their way home to Berlin. An account of my morning interview of this at Eberle's Alexandra Hotel was published in *The Times* and copied into Cassell's *Natural History*, vol. 1, p. 35. In the evening I supped with the gorilla *and* the professor and his friends. The next day they were good enough to bring it to the museum to see our recently-acquired stuffed adult specimen, and as many scientific friends as could be got together for the occasion. The creature was in the most buoyant health and spirits; gambolled gaily with the visitors, but showed only a stolid indifference to the specimen under glass. This gorilla was subsequently exhibited in the Aquarium at London, and died shortly after its return to Berlin. Other young gorillas have survived the voyage to Liverpool and been purchased by Mr. William Cross, the latest of which he sold to the Zoological Society of London in 1887, but it did not long survive. May a better fate be in store for the subject of the present notice!

The photograph was exhibited at the meeting of the Literary and Philosophical Society of Liverpool on the 18th inst.

Thomas J. Moore,

Free Public Museum, Liverpool, Feb. 21st, 1889.

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Puffin Island Biological Station.

ONE of the favourite topics for discussion amongst the philosophers of all ages has been the question of Life. What is life? whence came life? and whither doth life go? The definitions and explanations which rise with the very statement of the question bring a smile to the face of the nineteenth-century student. Charles Darwin taught us to collect facts and leave all large generalizations to a later day. Instead of discussing the old problems as to the origin and destiny of life, the modern student is confining his investigations to the manifestations of life in beast and bird and living thing, on land, in air, and in the world of waters. Biology, the science of life, is being divided into numerous sections, and biological laboratories are springing up in every part of the world. Instead of discussing abstruse philosophies the modern man is busy collecting facts, and if ever a solution is found to the old problem regarding the nature and origin of life it will be found by this method. There is a splendid laboratory at Naples; there are several in America; there is a well furnished one in Japan. The Russians have established several, and almost every government in the world which possesses a seaboard has now established a biological laboratory. The magnificent institution which was opened last year at Plymouth, marks the somewhat tardy recognition of the claims of biology by our own government. Amongst the private stations established on our shores, not one has a more remarkable history than that belonging to the Liverpool Biological Committee, which was opened a little less than two years ago. The leader of the post-Darwinian naturalists of Liverpool is Professor W. A. Herdman, and to his energy and enthusiasm is due the existence of the new station on Puffin Island, which has become so famous in the world's biological records. The island itself is at the mouth of the Menai Straits, which divide Anglesea from Carnarvon. It is a rocky limestone boss, about five-eighths of a mile long, 300 yards wide, and nearly 200 feet in height at the most elevated point of the ridge, which forms the back bone of the islet. It is cut off from Anglesea by a deep channel less than a mile in width, through which the tides of the Irish sea sweep at time with dangerous fury. Standing on the southern end of the island, looking towards the main land, one catches a glimpse of some of the most romantic country in the world. The Welsh hills are famed in song and story, interwoven as every hill and valley has been with the history of our own kings, and the feuds of restless, fiery British chieftains. The rocky shores have been marked by dreadful shipwrecks, which made them darkly famous in the records of a maritime race, but the chief interest of the panorama is surely that of the geologist!

At his feet lies the long spit of boulders and pebbles, where the biologists find their victims at low water. Across the tide-torn strait is the lighthouse on Penmon Point, while beyond it lie the rolling hills and deep gullies of the old Silurian age, and beyond them all, the clean cut, lava-capped, ash-wrapped summit of Mount Snowdon. The Menai Straits, the far-away suspension bridge, the tall, bleak felstones of Penmaenmawr, and the bold head of the carboniferous Great Orme, make a wonderful picture. Sometimes the steamer "Hyæna," belonging to the Salvage Association, lies in the little "bay" beside the spit, and gives a modern look to the beautiful picture, set in a frame of blue sea and bright blue sky, which seem to belong to a different land and a different time from this prosaic age of ours.

The island itself is formed of carboniferous limestone, and must once have formed part of the vast area which once comprised the Great Orme's Head, parts of Llangollen, the Vale of Clwyd, and many another remote place. The *Crinoids* lived and died in the clear, shallow seas of some long past age, and built these rocks from their shells. The enormous shellfish, the *Productus giçantea*, added to the mass with their shells of lime, while corals, and spirifers, and countless living things helped to build the hills which were to be, with their skeletons of carbonate of lime. Ages have come and gone; the world's surface has risen in some places and sunk in others; the ocean bottom has been elevated and the hill tops have been depressed; the rivers and seas, the frosts, and the floods have carved the elevated limestone, and now the Orme's Head towers high above a bonnie watering place, and the little boss of limestone, a small remainder, set in a stormy sea, forms the home of the biologists and is called Priestholme, or Puffin Island.

It is called the Holme of the Priest, because some time in the misty past, the priests built here a cell, and rich pilgrims came for absolution from their sins. One holy man, "St. Seiriol the Bright," who lived some "thirteen hundred years agone," according to Matthew Arnold, built a church on this island, and it stands there even unto this day.

No man knoweth to what age it belongs, but each new comer gives it a different date, and as none can prove when it was built, or by whom, each man is entitled to his own views. Certain it is that the old monks "builded better than they knew," for the pyramidal roof of the old tower is covered with the verdure of centuries, and the crumbling stones tell of the gentle influences of a long, long time, while the records of the life of the builders has perished entirely. War and time have dealt sadly with the records of the holy men, but the solid walls and broad foundations bear witness to their holy zeal. The seas have dealt hardly with the island, cutting it and wearing in quaint and curious ways, making strange sections of rock face in many places; piling up the broken rocks in others, as though left by the children of giants after a day's play. In some places they are cut and carved into fantastic forms, or hewn into straight, wall-like cliffs, as though wrought by the hands of a cunning master builder; but, while the seas have thus sculptured the rocks of the island, the winds have dealt gently with the ruins of St. Seiriol's Church.

In the year 1841 the Trustees of the Liverpool Dock Board erected a house on the northern end of the island as an observatory, from whence the men could watch the ships coming in from the sea, and keep up a system of semaphore signalling with other stations. The house was built well and strong, with four rooms, an attic, outhouse, and a long room for an observatory, while a giant flagstaff crowned the hill. The electric telegraph abolished the semaphore stations, and in 1863 the place was deserted. When we went down there nearly two years ago we found the house windowless and doorless, the haunt of land birds and sea birds, of rabbits and of goats, and of the Ishmaelites of society, who drifted there at times to catch rabbits with which the island swarmed.

The Lord of the Manor granted the use of the island to the biologists, and work was begun at once. Money and means were found by the enthusiastic biologists. Doors and windows were made and all kinds of fittings secured, so that by the month of May, 1887, they were ready to go down. The Liverpool Salvage Association lent their steamer, the "Hyæna"—the noblest roller that ever floated—and a jolly party went down and took possession. All the furniture and fittings were landed at the end of the island most remote from the house, and had to be carried the entire length of the island. It was a great day. Learned professors carried sacks of coal; Justices of the Peace shovelled coprolitic remainders from the floor of the long tenantless building; members of learned societies wrestled with planks and doors and window sashes, which were awkward to carry in a high wind; while a couple of Hyæna sailors nearly killed themselves with boxes of glass and tubs of provisions. But courage and enthusiasm overcomes all obstacles, and the party secured a roof for themselves, and, while a journalist cooked the first dinner, a magistrate laid the table, and a wealthy merchant wiped the dishes and knives and forks. With such a crew it was not difficult to put the place in order. The joiners put the doors and windows in; the old observatory with its bay window made an excellent laboratory, and the flag of the L.M.B.C. floated from the flagstaff, showing to the world—in passing vessels—that the Liverpool Marine Biological Committee had done for the city what governments and municipalities had been called on to do for other cities. A young man was installed

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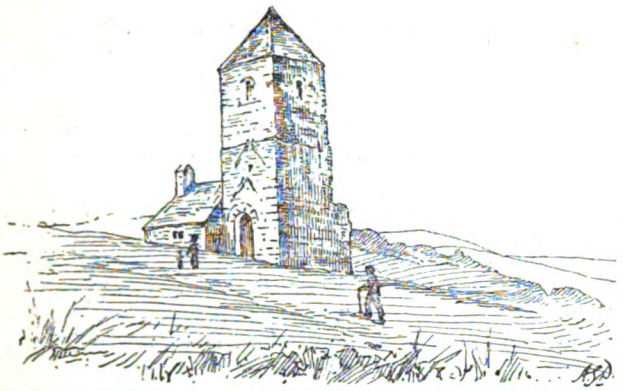
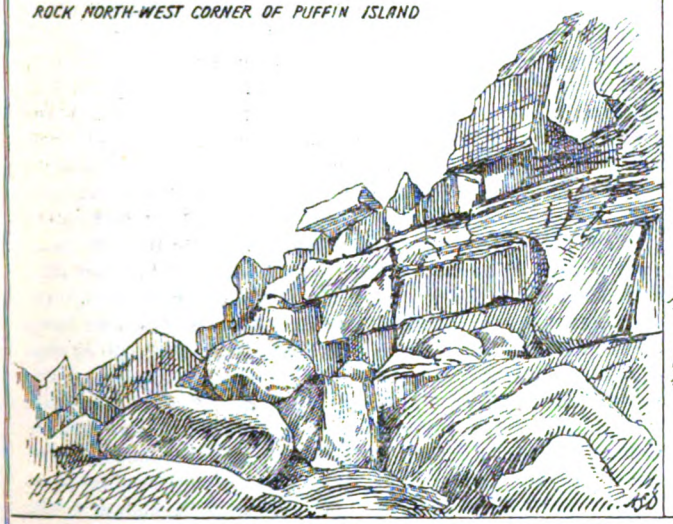
ANCIENT CHURCH TOWER. PUFFIN ISLAND.

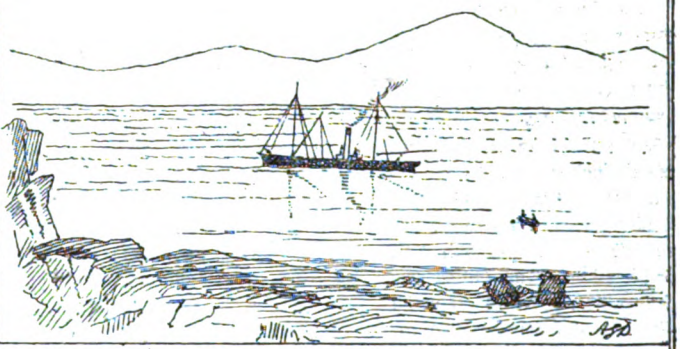


LIVERPOOL MARINE BIOLOGICAL STATION. PUFFIN ISLAND.

ROCK NORTH-WEST CORNER OF PUFFIN ISLAND



THE HYÆNA OFF PUFFIN ISLAND.



COAST OF ANGLESEY FROM PUFFIN ISLAND

• SKETCHES ON PUFFIN ISLAND •

MADE BY T. MELLARD READE, 28TH & 29TH MAY, 1888

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as curator and he soon took to himself a wife, and they are now dwelling *a la* Paul and Virginia on the limestone boss which is called Puffin Island.

On the rocky sides of this sea-washed islet the puffins make their home and lay their eggs in the clefts of the rock, or in the rabbit burrows, and the little sea-parrots look with wondering eyes at the biologists. Among the crannies of the lower rocks, when the tide is out, the students find rich treasures of tunicates, zoophytes, and polyzoans, amid the rocks which are alive with squirting molluscs (*Saxicava rugosa*), and flat, curious looking little crabs (*Porcellana platycheles*). On the higher slopes the botanist finds curious forms of plant life amid the scant flora of the place. The cuckoo-pint, the buckshorn plantain, the false hemlock, and the henbane flourish along with the delicate turquoise blue forget-me-not and the softly-tinted sea-pink. The geologist is for ever busy amid the layers of shaly marl, and clay and massy blocks of limestone, full of fossils, while the entomologist finds swarms of ants and beetles and creeping things under every stone and sod. The geological lore of the island is wonderful, and so was the monks' life, as attested by the crumbling tower and the deep, solid foundations of priestly places; but the new life which has come to the place with the men of science has a glory of its own which is quite as great as that which has been in the past. The students work there during the summer days and peer into the miracles of life on every side; but all through the winter the young keeper and his wife dwell there alone, keeping a record of wind and tide and living things, and keeping the students of the great city supplied with sea forms for laboratory work, and so are the stories of the past and the present mingled together in strange state on this little island in the sea which is called Puffin Island Biological Station. R. M.

The Branching of Trees.

THROUGH the long months of winter and the early weeks of spring Nature presents to her lovers very few of those charms which come upon us in such bewildering profusion in the more genial seasons of the year. It is in the interval that elapses between the time when the eye is greeted by the diversified browns of autumn and the tender greens of advanced spring with its welcome flowers, that less conspicuous charms, such as lie in the fantastic characteristics of fungi or the minute beauty of mosses, force themselves upon the attention of the earnest lover of plant-life. It is at this period that the trees, divested of foliage, exhibit to the best advantage their intricate and often beautiful modes of branching. Doubtless, to not a few, the bareness of the branches is repellent rather than interesting; but such persons have never cultivated the habit of following with their eyes the gradations of ramification from trunk to terminal twig in the trees which they are in the habit of passing, or they would not hold such an opinion. "The branching of trees," says Sir J. D. Hooker, "forms an admirable winter study, and one full of interest. It is sufficient to allude to the zig-zag branchlets of the oak, with rounded terminal buds; the graceful, straight twigs of the beech, with lancet-shaped buds; the bold, stout branchlets of the horse-chestnut, with ovoid buds; and the exquisite sub divided sprays of the elm, like lacework against the sky." A chance allusion in some book, or a more than ordinarily prolonged gaze into the head of a tree whilst the light is falling on it in a certain direction, first sets the observer on the way of noting the forms of boughs and of branchings; and, once having made a commencement, he soon becomes surprised to find what a variety of beautiful forms and effects greet his eye, as he occasionally glances up into the crowns of the trees which he passes in his walks. The pastime, too, has the advantage of allowing of pursuit in town as well as in the country, and in this respect there are no better objects for observation than the plane trees which flourish so well among our forests of bricks and mortar. Let any person who has never noticed the beauties of branching before stand beneath a plane (easily recognised at the present time of the year by its yellowish wood where the bark has peeled off, and by its pendulous tassels of globular fruit) and glance either directly or obliquely up at the terminations of its branches, as they spread out feather-like against a mass of white clouds or a moon-lit sky, and he will realise that the above quotation from Sir J. D. Hooker is no exaggeration.

The forms of branching which prevail in stems also obtain in roots, leaves and flowers. The term "branching," however, can be properly applied only to the development on an axis of lateral parts similar to that axis. Thus, the production of roots from stems is not branching, but of roots from roots and stems from stems. Branching in general is divided into two kinds—dichotomous and monopodial. Dichotomy signifies the division of the growing point—the mass of dividing cells, or single cell, as the case may be, which forms the organic apex of a root, shoot, or other axis—into two (rarely more) parts, which for the time grow with equal strength in two fresh directions, each new branch again dividing in a similar fashion, and so on for many series.

As this is a mode which occurs very seldom in flowering plants (vine tendrils are an example), being confined, with few exceptions, to the cryptogamia, we will not consider it any further, but will proceed with the monopodial form. Monopodial branching is that which occurs when the lateral branches appear to spring from one main stem, as is the case with nearly all flowering plants. The monopodial form, again, is divided into the racemose and the cymose. The term "racemose," as applied to the branching of trees, has precisely the same meaning as when applied to that of flowers, and imports that all the lateral branches spring from one main trunk, which grows more vigorously and produces more branches than any of its lateral members, which in turn develop in a similar manner. Nowhere is this better seen than in fir trees, with their beautiful tiers of branches rising pyramidally in regular gradation around the one main stem. The "cymose" mode of branching occurs when the growth of the main stem is arrested in some way, such as by the production of a flower or by stress of weather, development being carried on by lateral branches. This may occur in two ways. The terminal bud, as said, may form a flower which stops its further prolongation, or it may be destroyed, or it may wither in accordance with the habit of the plant, as in the lilac, whilst two opposite, or nearly opposite, lateral buds carry on the development of the branch, thus forming a fork or, as it is known, a false dichotomy. This is not uncommon, and may be well seen at the present season in the lilac, where the twigs will be found to end in either two or three buds; if the former, the proper apex will be seen to consist of a little dry point, and, if the latter, the middle bud is destined to become a flower. In the buckthorn the twig ends in a thorn. On lower and older portions of the plant the somewhat irregular fork-like arrangements arising from this are evident, though mixed up with the racemose system which is present to a more or less extent in nearly all shrubby and arborescent plants. The second and most common mode of cymose branching, known as the sympodial, differs only in having the growth continued by one lateral bud instead of by two, which may develop either entirely from one side of the axis or alternately from different sides. The latter of these two, or the alternate mode, is by far the most common in woody growths, and is effected with such a remarkable graduation of diameter from the old axis to the new, that the complete branch formed from one lateral growth upon another appears like one main stem, whilst the actual terminal growths become dwarfed, and seem like stunted lateral twigs. If a spray of birch be examined before the leaves appear, a condition that would tend to obscure the arrangement, most of the twigs will be found to end either in a catkin or in a small withered piece of branch, close to which is a lateral bud that will carry on the growth of

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the branch, it being from such lateral buds that the present axes have to a great extent been formed. Among the many other trees in which this mode of branching appears are the beech, the elm, and the hazel; the branching of each annual shoot apart from the apex in all these, however, is racemose.

One of the characteristics which must have struck all observers of branching is the beautiful gradation which marks the development from the main boughs to the ultimate twig. This is partly due to the order in which buds develop, which is acropetal, or from the base to the apex, the oldest consequently being the lowest; but probably it is chiefly owing to the fact that the rate of growth of the earliest formed branches, compared with those formed at a later date, is such that it enables the former to preserve their relatively greater size. If this were not so heavy branches would grow from slender ones—a condition which would be both unsymmetrical and prejudicial to any magnitude of growth, as many of the branches when they grew to any size would be likely to break off the weaker ones under the combined pressure of the wind and their own weight.

Characteristic as are the forms and outlines of particular species of trees, their special contours are subject to modification by association with other trees, by climate, by the nature of the soil and by the predominant direction of the wind. A ready illustration will be found in the Cedar of Lebanon, which, when growing away from other trees and under good conditions as to soil and situation, produces its lowermost series of branches at a very low position on the main stem, and continues to develope in the characteristic pyramidal shape, but when growing in company with other trees it produces a tall, simple trunk, with a flattish crown of branches at the top. The lower branches have appeared, but have suffered denudation—an effect which is said to be due to want of sufficient air, a condition which, as botanists known well, has much to do with the building up of the plant frame. The fine Cedar of Lebanon growing in the Chelsea Botanic Gardens is an excellent example, and one that shows also an alteration of form caused by the wind, viz., the blunting of its otherwise pointed top. Another curious effect of the wind is sometimes seen in trees situated near the coast, which have their branches growing wholly on one side of the tree, and that the side farthest away from the sea. Again: the differences owing to the nature of the soil and of the situation are such that the oak, when growing in elevated positions and in poor soil, becomes dwarfed to a bush, whilst in rich soils it attains that comparatively lofty growth and majestic spread that gain it so much admiration. Yet, in spite of all these variations from one type of form, due to what cause soever, trees preserve a certain originality of outline and branching arising from compactness or looseness, from slenderness or stoutness, from regularity or irregularity, which makes each kind generally recognisable to an observant eye, even when not in leaf. Under normal conditions, however, this characteristic shape stands clearly out. There is the oak, in which all the main boughs are large, and arise not very high on the trunk, giving the effect of strength, and causing them to look as if, Atlas-like, they could bear the world. In this tree three branches not infrequently arise very close to one another from the stem, producing a thickness and roughness which, together with a peculiar twist in their direction, due to their growth at right angles with the stem and to the frequent suppression of terminal buds referred to above as cymose branching, produce that fantastic appearance visible when a leafless old oak is seen against the sky. How widely different is the appearance of the birch, which, with its conspicuous silver and mottled stem gracefully draped in a suspended shower of delicate twigs terminated by flower-buds, baffles the attempt of leaf-denuding autumn and winter to make it look dull and lifeless! A curious feature of the branching in this tree is the presence in the larger individuals of bunchy aggregations of twigs that greatly resemble birds' nests—a shape which they derive from the arrest of their development. Quite in another style is the head of the beech, with sturdy limbs that spring from a high point on the trunk and rise obliquely upwards, tapering off to very fine twigs. On some of these the old fruit-cases are found persisting even into spring. A very masculine tree compared with the birch, but yet with a mode of growth which differs strikingly, by its regularity and by the acuteness of the angles at which it branches, from the oak. Again, how different are some of the pines from any of the foregoing; towering aloft from the needle-strewn earth, the whole tree, with its crown of finely-divided branches supported on a tall, simple trunk, has at a distance a palm-like appearance.

Most of these varieties in form are due in a great measure to the mode in which the branches arise, to their dimensions and to the suppression or non-suppression of terminal and lateral twigs. As the whole head of a tree may be said to be primarily divided into main boughs, so these in turn are divided into lesser boughs and sprays; and, as Gilpin has pointed out, the examination of a spray affords a key to the understanding of the main bough, for the latter mainly is but the perfect manifestation of characteristics indicated in the former. There is no better way of making such characteristics clear than by placing sprays, plucked from our commonest trees, against some kind of white screen, which at once throws out into relief many points of beauty and of interest. It is a curious and notable fact that the direction and spread of a particular tree has often been noted to be imitated in the branching of its root; for instance, the root arrangement of the oak consists of a large tap-root and numerous strong horizontal branches. The purpose of such an imitation is evidently to adapt the members under the soil to the support of those above it.

A few points on the relationship of branches to leaves are not without interest. The buds of all flowering plants, with few exceptions, arise in the angle formed by the leaf, or its stalk, with the stem. This is termed "axillary growth." It may be easily seen at the present time of the year in a twig bearing buds (one from the horse chestnut is to be preferred), when the scar of the leaf-stalk will be recognised at the base of the buds, or a spray from the oak on which some withered leaves still persist will exhibit the buds in the axes or angles. Leaves generally exceed branches in number, owing to the fact that many of the buds never develope into shoots from want of sufficient nourishment, or to destruction by external agency.

In conclusion, it should be borne in mind what an important part branching plays in giving to trees the variety of picturesque beauty which they possess; for, though the green leaf is one of the most beautiful things in nature, it is the manner in which masses of leaves are disposed upon branches that endows trees with that charm and character, nay, almost consciousness, which arouse in us a feeling of pleasure that almost passes into affection.

THEODORE W. DICKER.

Twenty Years of Microscopy.

BY ISAAC C. THOMPSON, F.L.S., F.R.M.S.

(Abstract of Presidential Address to Liverpool Microscopical Society, delivered January 18, 1889).

WE are met this evening to enter upon the twenty-first session of this society, and I thought I could not better inaugurate the honourable position in which you have placed me as occupant of this chair than by taking as a theme for some remarks "Our Coming of Age."

We delight in working out the life-history of lowly organisms, and obtaining some insight into the stages of their evolution from the embryo to the adult form. Let us this evening take a short survey of our own life-history as a living organized society, and see if we have developed the characteristics of which our embryonic form gave hope and promise.

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There never was a time when the microscope constituted so necessary and essential a condition in the study of any of the many increasing branches into which natural and physical science is divided as it does at present. To the geologist the microscope is no less essential than the hammer, revealing as it does not only the characters and composition of the various strata composing our earth, but also bringing before us the nature of the fauna and flora of bygone ages, enabling us to determine the relation of the past to the present. To the chemist and analyst the microscope is all-important, while in many branches of trade and manufacture, and as more recently exampled in brewing and baking, in connection with the process of fermentation, it has helped to unite science with industry, and thus to raise the standard of our commercial products.

This society came into existence at a time when there was much speculation upon matters connected with the origin and manifestations of the lowest forms of life, and the controversy waxed hot and strong. Biogenesis or abiogenesis was the question, and both sides were warmly espoused in our society. But, thanks to hard working members of our society and others, the whole question of biogenesis *v.* heterogenesis or abiogenesis, was decisively, and probably, for ever settled. The Rev. W. H. Dallinger was at the time, in conjunction with Dr. Drysdale, commencing the study of a minute septic organism found in a macerated infusion of cod's head. Their studies extended over months and years of close, careful watching, and stand out as a monument of accurate scientific microscopical research. Their results show that the life history of even a Cercomonad $\frac{1}{4000}$ of an inch in diameter is marked by no caprice, but passes regularly through a uniform series of metamorphoses of a distinctly marked character. Bastian assumed that low organisms were killed by exposure to a heat of 212°, and, having subjected his flasks to that degree of temperature and finding life again appeared in them, was satisfied that the life had sprung into existence *de novo*. Whereas, Drs. Dallinger and Drysdale, by careful experiment, also established the fact that most, if not all, adult forms were killed far below boiling point, viz., at 140° F., and in many cases at from 60° to 80°. But they also proved conclusively that the spores of the same organisms completely resisted 210° F., many of them surviving a dry heat of 250°, while the same were destroyed by a moist heat of 220°, though they do not by any means consider this 30° a fixed limit of difference between dry and moist. These experiments upon the thermal death point of known monad germs were many times repeated with the same results, and the doctrine of spontaneous generation may long since be considered to have received its death blow. Many other workers contributed to this result. Huxley took spontaneous generation for the text of his striking address before the British Association of 1870 in our own town, and the brilliant experiments of Tyndall as well as those of Pasteur were of themselves conclusive. Indeed, the whole of the immense trade done in preserved meats, tinned fruits, &c., during the last 20 years is the most telling reply to the apostles of abiogenesis, and this a result of the application of the microscope to the ordinary affairs of life, and of the many and increasing ways in which science is acting as the handmaid to industry.

If we turn from the commercial uses of the discovery as to the nature and prevalence of germs to that still more important part of the subject, viz., their relation to disease and health, we shall be still more impressed with the advances in microscopical knowledge during the last twenty years. Previous to that time germs were well known to be associated with disease, whether as the cause or effect, but little or nothing was known definitely as to the relation of particular germs to particular diseases. Now, thanks to an army of diligent workers, chiefly in Germany and Great Britain, aided by the best objectives, it has been completely established that definite micro-organisms are universally present in several well-known forms of disease, chemical or fermentative changes being set up in the organism's blood or tissues, which form a suitable nidus for their reception and propagation. These micro-organisms are known to be vegetable protophytes, and are subdivided into—(1) micrococci; (2) bacteria; (3) bacilli and spirobacteria. A distinguished member of our society, Dr. Barron, whom we welcome this evening as a vice-president, has for many years devoted his attention to the microscopical study of these organisms by means of Zeiss's homogeneous immersion high-power objectives, and has succeeded in separating and mounting a large number of these disease organisms, including those of erysipelas, small-pox, diphtheria, typhus, typhoid, spreading gangrene, anthrax, tubercle, leprosy, and septicemia. Many of these he described and illustrated in a paper read before this society.

Let us now turn from the advances made in the application of the microscope and see what proficiency has been made in the improvement of the instrument itself. If anyone were to ask what has been the distinguishing feature of the microscopical science of the last twenty years, the answer would undoubtedly be—the researches of Professor Abbe, of Jena, on the theory of the microscope. By his indefatigable and profound perception much that was vague has been made clear, errors have been dispelled, and the whole question of microscopical vision has been placed for the first time upon a sure mathematical and philosophical basis. The beauty and excellence of definition of achromatic lenses had been so much extolled, and the perfection of the instrument so dwelt upon by high authorities, that it had become to be an axiom of belief that the microscope was incapable of further improvement, and we had reached the ultimate limit of advance. But all this is changed, and, judging by the additions to knowledge respecting the microscope during the last decade, he would indeed be rash who supposed that the acme of perfection was at all yet within our grasp; and assuredly as we advance in true knowledge of the theory of microscopical vision we are paving the way for excellence of manipulation.

No summary or epitome of the results of microscopical investigations during the last twenty years could be complete without alluding to the remarkable impulse given to all branches of biological research through the life and doctrines of Charles Darwin. In his wonderfully interesting biography Francis Darwin says of his father—"He always had a liking for the simple microscope, maintaining that it was too much neglected, and that we ought always to see as much as possible with the simple before taking to the compound microscope." And in one of Darwin's letters he says he always suspects the work of a man who never uses the simple microscope.

So much for the past. What about the future? What may the next twenty years reveal to us, or what will the possibly yet unborn president who will write our Jubilee address have to tell us? The microscope has already revealed to us the astonishing fact that every individual being, whether man or cabbage, infusorian or ape, is in its own individual existence (easily traced) but a gradual development from a speck of animated jelly to his or its mature condition. But beyond this is an impenetratable barrier which neither microscopist, chemist, or biologist is yet able to break down. And perhaps, as Darwin puts it, "It is mere rubbish thinking at present of the origin of life; one might as well think of the origin of matter." Some of the old questions will continue to perplex us, and if we have settled abiogenesis in the past biogenesis gives us no answer to the oft repeated question, "What is life?" Shall we then be any nearer the answer than we are to-day? We Microscopists (says the naturalist, Leydig), it appears to me, find ourselves also in the position of one who has been for a long time studying life as he would a meadow or a wood from a distance, and fancies if he could only get nearer so as to see under his eyes the individual plants which make up the verdant surface, he would at once attain to a better understanding of the process of growth of the plant and the fading of the leaf. Truly, he would learn many new things of

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interest, but the main point would remain as much a riddle as before, the same questions would remain to be answered, but they would apply now to the individual plant instead of to the verdant landscape as a whole.

We have in the present day groped with some success a few stages into the history of the individual plants in the visionary field of Leydig, but are placed with the problem of the molecular organisation of matter, over which an impassable veil is at present drawn forbidding entrance to the eye of science; and we can only stand and admire with wonder the inscrutable wisdom by which the laws of the universe have been founded, though many of them remain unread by our finite intelligence. In conclusion, let me express the sincere hope that in this year of our coming of age we may feel the responsibility of having as a society arrived at man's estate, and that some of those who have hitherto found in the microscope simply a pleasant means of recreation may use it towards some definite end, which shall raise both themselves and the Liverpool Microscopical Society, and have for its object the advancement of science and the spread of truth and knowledge.

Notes in Brief.

A NEW mineral is reported to have been discovered at Sudbury, Ontario, by Mr. Sperry, chemist to the Canadian Copper Company. It is a compound of arsenic and platinum, and has been christened "Sperrylite," after the name of its discoverer.

A bed of rock-salt has been found on Walney Island, Barrow, where it was struck at a depth of 300 feet, in the course of a boring for coal. The bed of rock-salt is stated to be 70 feet in thickness. The Salt Union will probably have here a new competitor.

IT is now a penal offence to kill sand grouse. The Act of prohibition came into force on the 1st ult. A few weeks prior to that date two fine specimens were shot at Wantage. The Act will remain in operation for three years, during which time it is to be hoped that this bird will permanently establish itself on our shores.

ANOTHER bird which is a rare visitant to Europe was shot recently in the Island of Möen, in Denmark. The home of this bird (*Cursorius Isabellinus*) is in the Desert of Sahara.

THE mildness of the weather in January and the early part of February was exemplified in the county of Norfolk by the large number of species of wild flowers found in blossom. A correspondent of *The Times* enumerates as many as 70 different species, the most remarkable amongst which were the poppy, white ox-eye, strawberry, pimpernel, primrose, and field scabious.

MEDICAL men in France are exercising themselves with the object of finding a cure for tuberculosis, and a fund of £4,000 has been established for this purpose by Professor Verneuil.

INOCULATIONS against bites from rabid animals have been performed at the Odessa Bacteriological Station during last year, with results no less satisfactory than those of the preceding year. The total number of persons inoculated was 454. Six patients died during or after the inoculations.

THE new librarian of the British Museum has instituted a regulation whereby novels published within five years will not be issued to readers unless special reasons are given at the time of application. This new rule will remove a number of idlers from the Library, and give more space for students and other subjects than the modern literature of romance.

MRS. PROCTOR, widow of the late Mr. Richard A. Proctor, the well-known astronomer and editor of *Knowledge*, has been granted a civil list pension of £100 a year.

THE pretty "frost powder"—so effective a decoration upon flowers and ornaments in ball rooms—has been denounced as a source of much danger to health. The "powder" is composed of thousands of particles of glass, which soon float in the air of a heated room, and, being inhaled by the persons present, cause irritation of the throat and eyes, leading often to troubles of a serious nature.

THE following gentlemen have been selected by the members of the Leeds Geological Association to represent the association upon the local committee appointed to make arrangements for the visit of the British Association in 1890:—Messrs J. E. Bedford, F.G.S. (president), R. Holgate, F.G.S., and Wm. Cheetham (vice-presidents).

GLACIAL geology is making headway in the States. Professor J. W. Spencer, who has just received the appointment of State Geologist of Georgia, is busily engaged in investigating the physical history of the great lakes of North America—a question which has long been agitating rival schools of geological thought. Professor Spencer's conclusions are awaited with much interest on this side of the Atlantic.

REFERRING to our "Note in Brief" of last month on the disappearance of a rare plant in Scotland, several complaints have appeared in the press as to the unhappy results of depredations by collectors. The *Euphorbia pilosa* is another doomed species, and *Lactuca emuca* and *Osmunda regalis*, formerly common on our moss land, have entirely disappeared from several of their old haunts.

PROTECTION for our rare plants seems quite as desirable of attainment as protection for the sand grouse. Landlords would do well if they would instruct their gamekeepers and others to take measures for the preservation of such plants on their properties as are in danger of becoming quite extinct. The mania for "collecting" once indulged in seems only to "grow by what it feeds on."

AMERICAN geologists seem to be entering with great zest on the study of physical problems of the earth. In this connection Mr. Mellard Reade's novel theory of mountain formation—recently expounded in these columns and more completely in his own larger volume—has attracted a considerable amount of attention from the most eminent geologists of America as well as of Europe.

PROFESSOR E. W. CLAYPOLE, of Philadelphia, has discussed in the *American Geologist* the effect, on current geological thought, of the discovery—which Mr. Mellard Reade was the first to make—of a "level of no strain" in a cooling globe. In a recent issue of the same magazine Mr. Reade succeeds in throwing much clear light on the question, which is one not altogether easy to comprehend without a careful study of his work; and he shows that the mathematical determination of the depth of this "level of no strain" in the earth's crust does not affect the question of the general rigidity of the globe in the manner assumed by Professor Claypole.

AN interesting and novel application of the polariscope to the lantern was shown by Mr. W. Leach, at a recent meeting of the Manchester Microscopical Society, for the purpose of illustrating rock sections and the optical properties of minerals.

THE previous exhibitions of the Royal Meteorological Society having been successful, the council will hold next month an exhibition of instruments for atmospheric physics invented during the last ten years, especially those used for solar radiation observations.

THE Metropolitan Scientific Association have re-elected as their president Mr. W. Semmons (notwithstanding the fact that he has left London), to mark their appreciation of that gentleman's good work in connection with the society.

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ACCORDING to a Brazilian journal, the mineral wealth of Brazil is now being opened out in new directions. Silver, lead, iron, antimony, and aluminium are abundant. Gold is worked in the provinces of Minas Geraes, Bahia, St. Paul, and Rio Grande. Many coloured marbles are also produced, and there are in the country large coal mines.

THROUGH the generosity of Mr. Henry Tate a new scholarship commemorating the name of the late Rev. Charles Beard has been founded at the University College, Liverpool, to be directed towards the promotion of historical study and research. Mr. Tate has also purchased the Shadford Walker collection of engravings, and placed it at the disposal of the Roscoe Professor of Art for lecture illustration.

A NEW laboratory, to accommodate 80 students in practical and astronomical physics, has been added to the Normal School of Science.

CELESTIAL photography is making great strides. Mr. Isaac Roberts has just created a sensation with his fine photographs of the great nebula in Andromeda, and now Mr. A. A. Common has completed the construction of his five-foot telescope, which has given very satisfactory results.

A WELSH river has lately vanished. The little river Gwenfro, which flowed through Wrexham into the Dee, has disappeared through a "swallow hole" near Gatewen colliery. The puzzle is now to find out what has become of the water.

ON the 14th February Sir Henry Roscoe, M.P., distributed the scholarships and awards to the students of the Central Higher Schools of the Sheffield School Board.

ON Saturday, February 11th, Prince Albert Victor presented the prizes to the successful students of the Science and Art Classes of the York Institute. The meeting was attended by a crowded audience. The Dean of York, in the name of the committee and members of the Institute, gave a hearty welcome to His Royal Highness, who met with an enthusiastic reception from the audience.

THERE has been formed at Woolton, near Liverpool, a gardener's society, for the purpose of mutual improvement by the discussion of horticultural subjects, scientific and practical, and providing a library of general reference. The first president is Mr. Holbrook Gaskell, who very warmly supports the movement. The society is the outcome of a course of lectures on botany, delivered at Woolton, by Mr. Harvey Gibson, of University College, Liverpool.

THE gold medal of the Royal Astronomical Society has been awarded to M. Loewy, of the Paris Observatory, for his equatorial condé, his method of determining the constant of aberration, and other astronomical researches.

STEPS are being taken by those interested in the fishing industry round the Irish and British coasts to petition the Government, through the Lord Lieutenant of Ireland, against the employment by American fishermen of the large purse seine nets for mackerel fishing. It seems very certain that these nets have proved very detrimental to the fishing off the American coast, and it is highly desirable that most careful attention should be directed to the proposed use of such nets on British coasts, lest similar mischief may be caused here.

Earthquake in Lancashire.

EARTHQUAKE shocks of noticeable proportions are not of such frequent occurrence in England as to allow them, when they do occur, to be passed over without comment. In many parts of Lancashire, on the night of Sunday, the 10th ult., at about 10-40, a slight shock of earthquake was distinctly felt, and several observers have reported their experiences. Many who did not feel the shock are disposed to make light of such unusual seismological phenomena, but the effects which accompanied this latest seismic visitation to Lancashire were sufficiently characteristic as to allay all doubts that might arise as to the real nature of the earth vibration. This is not the first time that the district in question has been affected in a similar manner. Shocks were felt in 1753, 1768, 1777, 1795, 1816, 1835. 1843, 1853, and 1863, all of which gave very distinct indications in the vicinity of Manchester and the neighbouring towns. A serious shock was also experienced in 1869, since which time the disturbing forces have been quiescent.

The earthquake of last month was very mild in its effects. Bolton appeared to be the centre of the chief disturbance. Here there was felt a heavy shock, then a tremor; doors were banged up; light articles danced in the house; and one man who was sitting in front of a fire was thrown forward into the grate. At Crosby the shock was felt distinctly as an undulatory movement from north west to south east. Rumbling noises were heard at Worsley, at Greenhaugh, near Kirkham, Farnworth, near Bolton, and at Horwich. At Manchester the shock was very marked, and it was also felt in Liverpool and the surrounding districts. The connection between the formation of geological faults and of earthquake movements has been pointed out by Dr. C. Ricketts, F.G.S., and other observers, and it is noteworthy that at Heapey, near Chorley, where there are many faults, the shock was particularly perceptible, one villa being struck three times, and subjected to several oscillations. A district of Perthshire, near Comrie, situated in the vicinity of the great Caledonian fault, is hardly ever free from earthquake vibrations of greater or less intensity.

This Lancashire earthquake has evidently set people thinking on the causes of these phenomena, as will be seen from our report of a meeting of the Manchester Geological Society. "Centrifugal earthquakes" are, however, new to science, and their *modus operandi* was not explained by the author of the recent paper with that degree of lucidity which the late Mr. Mathew Arnold conceived in the affairs of this world to be so necessary.

Diamonds in Meteorites.

THE late Professor Carvill Lewis, of Philadelphia, carefully examined a fragment of a meteorite which fell in Siberia two years ago. He extracted from it two small oval bodies with extremely high index of refraction, and showing only slight traces of polarization, such as is common in many diamonds. These bodies were colourless and beautifully transparent, resembling certain specimens of Brazilian "bort." Having been able to distinctly scratch a polished sapphire with portions of the meteorite, the Professor considered that these bodies were true diamonds. The olivine in this meteorite was also in the form of oval grains, and had a deep yellow colour and bright polarization. The rounded form of the olivine and the diamonds may have been due to corrosion of the igneous mass, as this peculiar form is very commonly shown by the olivines in basic eruptive rocks. Carbon has long been known to be found in meteorites in its graphitic or amorphous form; in fact, cliftonite - a cubical form of carbon—is found in many specimens of Australian meteorites. As carbon and diamond are intimately related, the important bearing of the present discovery upon the vexed question of the diamond is evident. Diamonds occur in, or in the neighbourhood of, basic eruptive rocks, and the facts regarding the associations of the diamond in Africa, Borneo, New South Wales, California, and elsewhere, all point to peridotites as the matrix of the diamond. There is a strongly-marked similarity, both in structure and composition, between the diamond-bearing kimberlite of South Africa and the meteorites. The discovery bears out the conclusions to which Professors Latschinof and Jerofeief came on their examination of the same meteorite—that diamond fragments were in it. This will occasion a raid on meteorites, to see if any of these precious stones can be obtained of sufficient size to pay the cost of the labour; and it may put some one on the track of the artificial production of the most valuable of all minerals.

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Museum Notes.

LIVERPOOL MUSEUM.—One of the recent additions to the Museum is a fine specimen of the skull and horns of Marco Polo's wild sheep *(Ovis Poli)*. This animal is an inhabitant of the heights of Gilghat, in Central Asia, where it roams at an elevation of from 10,000 to 16,000 feet. Only one complete skeleton of this wild sheep is known in any European collection.

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MUSEUM LECTURES.—The Monday evening lectures at the Liverpool Museum continue to be attractive to visitors, and a noticeable result of these meetings is the increased attendance on Saturday afternoons of working men, who bring with them their wives and families. A greater interest is naturally taken in objects displayed in a museum when their nature and history are made the subjects of popular *viva voce* exposition. Mr. W. A. Argent lectured on one evening on "Music in Bygone Times," with illustrations performed on some ancient musical instruments in the Mayer collection.

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MANCHESTER MUSEUM.—Professor Williamson delivered, at Owens College, an instructive address on the "Vegetation of the Earth During the Secondary Period." He said that the oolitic strata stretched irregularly from Flamborough Head and Lincolnshire far down towards Bristol and Dorsetshire, and many of the cuttings on the main London and North-Western line, between Rugby and Stafford, were made through these beds. The fossils found in them disclosed the fact that the oolitic ferns bore a closer resemblance to the modern species of ferns than any that had preceded them. The lecturer spoke of the abundance of lycopods and cycads, and went on to touch upon tree ferns. Australia was essentially the land of tree ferns to-day. The plants only had their home in the southern hemisphere. They flourished best near, but not within, the tropic zone. They were found in New Zealand, in the region north of Cape Colony, in the West India Islands, and in Central America, thus forming, as it were, a belt all round the globe. But though these were the limits of the tree ferns now, there was plenty of evidence to show that at one time the cycads had been as abundant at the Arctic regions as they were now in Australia, and in the oolitic rocks of Europe, India, and to some extent of the United States, plenteous traces of their former existence had been preserved. After the lecture the Professor conducted his audience through the museum to examine with them a larger number of specimens than could be shown in the theatre.

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THE geological collection at the Manchester Museum at Owens College is now almost complete. The Tertiary specimens are not finally arranged, and that part of the museum which is devoted to the collections of biology has not yet been thrown open to the public. Mr. Percy F. Kendall, the assistant curator, has arranged a fine series of volcanic rocks from the island of Mull, which, together with the display of maps, charts, and local geological photographs, illustrate in as graphic a manner as is possible in a museum the geology of this interesting region.

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THE BARRAS BRIDGE MUSEUM, NEWCASTLE.—On Saturday afternoon, January 26th, a large number of the working classes assembled in this museum for the purpose of inspecting its contents, under the guidance of several naturalists, among whom were Mr. John Hancock, Mr. Howse, Mr. Adamson, Mr. Dinning, Mr. R. J. Green, Mr. Graham, Mr. Thompson, and other well-known students of natural history. Alderman Barkas delivered a popular lecture in the south corridor, and afterwards described the fossils and birds. Subsequent meetings on Saturday afternoons have also been well attended, and much interest has been shown in the examination the museum contents.

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MR. HENRY CLARK, in an address to the West Kirby Literary Society, has recently called attention to the lessons in history to be derived from a study of the collections of antique ivories to be seen in our great public museums. The beautiful examples of carved pyxes and crucifixes in ivory not only testify to the religious enthusiasm of early days, but illustrate the progress and advance of art. The fine series of ivories in the Mayer Museum at Liverpool includes some magnificent examples of Egyptian and Byzantine workmanship.

MR. G. H. MORTON, F.G.S., gave, on another evening, an address on the local rocks and fossils of the neighbourhood of Liverpool; whilst on subsequent evennigs Mr. D. Clague, F.G.S., and the Rev. Samuel Gasking, B.A., F.G.S., lectured respectively on "Minerals, and How to Read Them," and "Star Fishes."

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SOUTH KENSINGTON MUSEUM.—A very beautiful and rare specimen of Flemish tapestry weaving, possibly of Bruges or Brussels manufacture of the end of the fifteenth century, has just been added to this museum. It consists of a small wall-panel, originally intended to hang above an altar. It is over six feet in length and five feet in width. Its texture is remarkable from the fact that there are 26 warp threads to every inch of height, or about 1,570 horizontal warp threads in the entire piece. On each inch of warp thread there are some 60 twists of weft threads, amounting to nearly seven and a quarter millions of weft twists over the whole panel. This unrivalled specimen of textile manufacture was formerly in the possession of the late well-known art collector of Rome, Signor Alessandro Castellani, from whose executors it has been purchased.

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THE TRUSTEES of the Australian Museum, Sydney, have acquired the manuscript and drawings of the late Mr. A. W. Scott's life-histories of the Australian lepidoptera, which they have arranged to publish. Mrs. E. Forde and Mr. A Sidney Olliff will edit and revise the voluminous material.

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AN addition of great interest has been made to the Museum of Archæology, Cambridge, consisting of a large number of relics from a Saxon burial-ground disinterred in a field near St. John's College. The objects found include thirty skeletons, one hundred urns, and many ornaments of interest and value to antiquarians.

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WE have received from Baron A. von Hügel, Curator, the Annual Reports of the Antiquarian Committee to the Senate of Cambridge University from 1885 to the present time, giving the history of the establishment of the Museum of General and Local Archæology, opened in 1884, and lists of accessions or donations to the museum. The collections chiefly consist of pre-historic British, Roman, Saxon, and Mediæval antiquities, the Gordon collection of ethnological specimens from Fiji Islands, and the celebrated Maudsley collection of casts from original sculptures in the buried cities of Guatemala, together with miscellaneous antiquarian objects and historical relics.

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A SERIES of Saturday afternoon lectures has been commenced in the South Kensington Museum Lecture Theatre. The opening addresses were given by Professor J. Norman Lockyer, F.R.S., on the "Meteoric Origin of the Heavenly Bodies and the Earth."

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AT the Walker Art Gallery, Liverpool, it is proposed to hold, during the ensuing summer months, an exhibition of art decoration, embroidery, wood-carving, ceramics, metal wares, binding, and other art work.

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NEWCASTLE-ON-TYNE MUSEUM.—The curator of this institution (Mr. Richard Howse) has published an illustrated catalogue of the fossil plants in the Hutton collection, in which is also given a history of this celebrated collection.

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CONFERENCE OF LIBRARIANS.—The quarterly conference of the Librarians of the Mersey District was held at the Bootle Free Library and Museum, on February 8th. The s.s. "Celtic" was visited in the afternoon. At the business meeting which followed, papers were read on "The Relation of the Free Library to Technical Instruction," and "Notes on the Barrow-in-Furness Free Library;" the former by Mr. A. Lancaster, Public Librarian of St. Helens, and the latter on behalf of Mr. J. Frowde, of Barrow, by Mr. T. Formby, of the Free Library, Liverpool. Full and practical discussion followed, in which most of those present took part. A report of a Committee on the Classification of Fiction was presented and approved. The usual votes of thanks terminated the proceedings.

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Our Portrait Gallery.

IX.—PROFESSOR W. BOYD DAWKINS, M.A., F.R.S., &c.

THE borderland of history is a region where the geologist and the antiquary meet on common ground. In bridging over the gap where the discoveries of the geologist terminate and the investigations of the historiographer are carried to their furthest limit, no scientific worker has achieved more solid and practical results than have accrued from the labours of the subject of our present sketch. It requires something more than the mere collection of antique objects, and the acquisition of ancient lore, which were almost the sole qualifications of the antiquary of earlier days, to arrive at accurate conclusions respecting the physical state of the earth, and the condition of its inhabitants, at the period immediately anterior to that of which we possess any historical or traditional record. Geological considerations are a necessary part of archæological investigations, yet this knowledge has only been specially studied by a few. Professor DAWKINS was one of the first to point out the absolute continuity which exists between the work of the geologist and that of the archæologist, and his labours in many new directions have been so fruitful of results, and have thrown so much light on problems hitherto unsolvable, that it is hardly an exaggeration to say that we owe to the author of "Early Man in Britain" the introduction of a new science. Prehistoric remains have now become recognised factors in scientific research. They can, in many cases, be assigned to specific periods or stages of civilisation, with as much certainty as the fossils of the different strata can be relegated to their proper sequence in the geological record.

But it is not alone in the entrancing domain of prehistoric archæology that Professor DAWKINS has distinguished himself. As a geologist and palæontologist his many papers and memoirs contributed to the Geological Society and other learned bodies, and his work on the geological survey of Great Britain, indicate the high character of his researches. As an engineer he has shown the rare ability of combining the poetry of science with its more purely economical aspect. A prolonged visit to Australia, followed by a tour in the United States and other countries, proved the value of his judgment and advice in matters relating to water supply and mining. More recently, in connection with the famous Channel Tunnel scheme, of which Professor DAWKINS is an ardent supporter, he has undertaken the responsibility of the geological surveys of the English and French coasts for that enterprise.

In matters of education Professor DAWKINS has attained a recognised position as Professor of Geology and Palæontology in the Victoria University, Manchester. The Manchester Museum, Owens College, is indebted to his exertions as Curator for the excellent system of arrangement of the fine collections now bestowed within its walls, the result of many years of labour and experience gathered from a systematic exploration of the principal museums on the Continent and in America. In 1873 Professor DAWKINS (having previously explored the most important British collections) made a special visit to the Continent for the purpose of sifting the evidence as to the determination of species, and of the localities of specimens contained in many of the larger museums by examinations on the spot. This work was carried on in association with some of the most distinguished foreign anthropologists and palæontologists, amongst whom we may mention Lartet, Capellini, Broca, Virchow, and Bastian. The materials thus collected have been partly used in his volume "Cave-Hunting," published in 1874 (which has been since translated into German), and in "Early Man in Britain," which appeared in 1880.

We will now give some brief biographical details, which will be of interest to our readers.

WILLIAM BOYD DAWKINS is the son of the Rev. Richard and Mary Ann Dawkins, and was born at Buttington Parsonage, Welshpool, Montgomeryshire, on December 26th, 1838. Educated at Rossall School, Fleetwood, he afterwards became a Hon. Fellow of Jesus College, Oxford, where he gained an exhibition and scholarship in classics, a first class in physical science, and other distinctions. His scientific studies were carried on under the direction of the late Professors Rolleston and Phillips. In 1859 he explored Wookey Hole, where the discovery of fossil bones had just then been made, and commenced a series of cave explorations in various parts of Great Britain. These he has carried on for the last thirty years, during which time scarcely any cave—certainly not one of any importance—has been opened in England which has not been visited by Professor DAWKINS.

In 1861 he was elected Fellow of the Geological Society and joined the staff of the Geological Survey, devoting his official energies principally to the south-east of England. Six years later he became Fellow of the Royal Society, and afterwards of the Society of Antiquaries and member of the Anthropological Institute, and Associate of the Institute of Civil Engineers. In 1869 he left the Survey, and in 1873 he entered upon his professional duties at Owens College.

During the winter of 1880 he gave the Lowell lectures at Boston, and whilst in the United States studied the Universities and the various museums of that country, especially noting the famous collections of Agassiz, Marsh, and Cope. He has within the last month been awarded the Lyell Medal, by the Geological Society, for his researches.

Amongst the recent labours of Professor DAWKINS may be mentioned his Survey, in 1885, of the Antiquities of the Isle of Man. Through his efforts the Manx legislature passed a law for the preservation of the many valuable and

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PROFESSOR W. BOYD DAWKINS, M.A., F.R.S., &c.

"Research" Portrait.—No. IX.—*March 1st, 1889.*

From a Photograph by George A. Dean, Douglas.

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interesting prehistoric tumuli and other remains so plentifully scattered over the islands. These included the beautiful series of old Celto-Scandinavian crosses, sculptured with inscriptions in Runic characters and covered with elaborate and peculiar designs, the origin of which Professor DAWKINS has recently succeeded in tracing to a Germanic source in Gaul.

The little island of Mona, having enjoyed "Home Rule" for many centuries of its history, is outside the jurisdiction of the Geological Survey of England. The island has, therefore, never been surveyed by the British Government officials. Professor DAWKINS has been for some time engaged on this much-needed work. These investigations are still in progress, and their results are being awaited with great interest by geological students.

At the last meeting of the British Association, at Bath, Professor DAWKINS presided over the Geological Section, and in his address referred specially to the progress of our knowledge of the fauna and flora of the Tertiary period, showing that no break could be found either in the continuity in the series of events from the Pleistocene to the pre-historic ages, or in those which connect the pre-historic with the period embraced by history. He claimed that geology should present a universal history of the various phases through which the earth and its inhabitants have passed in the various periods, until ultimately the story of the earth is merged in the story of Man and his recorded works. Thus the science of geology becomes the true link between the Present and the Past—a principle which is entirely borne out by the many original investigations and discoveries to which Professor DAWKINS has devoted himself throughout his active scientific career. O. W. J.

More about Dust-Particles in Air.

AT the meeting of the Royal Society of Edinburgh, on the 4th February, Mr. John Aitken exhibited an improved form of apparatus for determining the number of dust-particles in the air. In our December number we gave the description of his first apparatus. This is much simpler and more portable. He showed the Fellows the marvellous fine rain which was deposited on the silver plate on account of the dust-particles in the diluted air seizing the moisture when the pressure was reduced by means of the air-pump. It was a remarkable and beautiful sight. He has been examining the purest country air during January. At Colmonell, in Dumfriesshire, where the air is considered to be remarkably pure, he counted one day 155,800 particles in a cubic inch of air; and two days afterwards—rain intervening—he counted only 8,200. This is the smallest number he has yet counted. At Ballantrae he counted 82,000 in the cubic inch. Falkirk lies in a colliery district; on the hills near it he found 180,400 particles, and nearer the town 2,296,000 particles in the cubic inch. He examined the air of Edinburgh by placing a tube outside a window of the Royal Society room, and showed that there are no less than 1,230,000 dust-particles in a cubic inch of air, whereas in the room itself there were no fewer than four millions of particles in a cubic inch. He examined the air near the ceiling, where gas jets had been burning for some time, and showed the Fellows that the amount there was tenfold. The paper was a most interesting one.

The Theory of Heredity.

AT a later meeting of the Royal Society of Edinburgh, on the 21st January, Mr. J. A. Thomson gave the outline of a most interesting paper on the history and theory of heredity. It is generally allowed that there is a general resemblance between a child and one of its parents. Many have observed that, while the child has certain individual traits, it sometimes had in it the general character and idiosyncrasy of a grandfather or a grandmother; in fact, there seems a constant tendency of offspring not to resemble its parents so closely as its ancestors. The problem, then, is as to the combination in the child of two opposing elements—the individual character and the physical, and, to some extent, constitutional heredity. The germ-cell in an embryo is different from all other cells; and modern biologists have insisted on the fact of germinal continuity, in accordance with which a certain number of cells were set apart to remain unchanged, and to form the reproductive cells of the next generation. Weissman, the German biologist, holds that no individually acquired characters can be transmitted; but there are facts which this theory cannot account for. Mr. Thomson holds a medium view between that of Weissman and that of Galton, and is of opinion that, while some cells transmitted from parent to child are intended for the building up of the individual by rapid propagation under the action of assimilating food, there are other cells which are retained in the offspring undeveloped, to be kept intact for the purpose of reproduction. The former developed the fluctuating individual element, and the latter the permanent hereditary element. He mentioned a very curious instance of the determination of the sex by means of food. In common tadpoles 46 per cent. are generally developed into female frogs; but a professor, by means of a peculiar kind of food which he gave to the tadpoles, actually raised the percentage of females to 92—just double what was before. Surely we must acknowledge that the science of embryology is only in its infancy.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between January 16th and February 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board:—

(*a*) Barometer	Highest (January 27th)	30·62	Inches
,, ,,	Lowest (February 3rd)	29·19	,,
,, ,,	Mean	30·005	,,
,, ,,	,, for 22 years January	29·915	,,
,, ,,	,, ,, February	29·928	,,
Temperature	Highest (February 1st)	54·5	Deg. F.
,,	Lowest (February 10th)	21·6	,,
,,	Mean	40·7	,,
,,	,, for 22 years January	39·1	,,
,,	,, ,, February	41·0	,,
,,	,, of Evaporation	38·6	,,
,,	,, ,, for 22 years January	37·4	,,
,,	,, ,, ,, February	35·9	,,
(*b*) Rainfall	Amount	2·376	Inches
,, ,,	Mean for 22 years January	2·239	,,
,, ,,	,, ,, February	1·56	,,
,,	Number of Days on which Rain fell	24	
,,	Greatest fall in 24 Hours (February 4th)	0·540	Inches
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·4	
,,	,, ,, for 22 years January	7·1	
,,	,, ,, February	7·2	
(*c*) Wind	Velocity, Greatest (February 2nd)	64	Miles.
,,	,, Least (January 23rd)	1	,,
,,	,, Mean Hourly	24·2	,,
,,	Greatest Pressure on Square Foot (Feb. 8, 8·40 p.m.)	46·6	Pounds.
,,	Direction at time of Greatest Pressure	WNW	

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Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
36	11	38	29	109	289	147	85	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

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Bolton.

During the third week of Jauuary barometric pressure, after a slight depression on the 16th, continued to rise through the week, gentle Easterly or S.E. winds prevailing. Weather gloomy, with slight rain each day from the 16th to 20th. Temperature above the average. Barometer averaged for the week 30·20″; mean temperature 40·1°; sunshine total 1 hour 46 minutes; rain 0·365″; relative humidity 90%.

From the 22nd to the close of the month, with the exception of the 27th, when the mean was 33·45°, the weather was very mild. In the early part of the period an anti-cyclone lay off the West of Ireland, and high readings were recorded here; on the 27th, after it had passed away to the Eastward, a rapid depression took place, accompanied by Southerly wind and rain. Towards the end of the month the gradients of pressure were steep and irregular, producing fresh to strong Westerly breezes. More or less rain fell on 8 days. Averages: barometer 30·248″; temperature 41·06°; total sunshine 5 hours 46 minutes; rain 1·284″; humidity 89·5%.

The mean barometric pressure for January was 30·15″, rather above the average, and the range 1·5 in.; the corrected mean temperature, 38·34°, is about 2·5° above the average; the humidity being high, 90·6%, accounts for the small amount of sunshine recorded—13 hours 15 minutes; rainfall, 1·827 in., is less than during the last or the preceding January, and only just half the average of the district.

The unsettled weather referred to at the close of January became more pronounced on the 2nd of February. The first day was unusually mild, with South wind, and mean temperature 48·75°. On the 2nd pressure and temperature decreased rapidly, and hail, rain, sleet, and thunder, with strong Westerly winds, at times blowing half a gale, continued to the 4th. The averages for the week are:—Barometer 29·776″; temperature 38·86°; sunshine 13 hours 58 minutes; rain on 6 days 0·867 in.; humidity 82%; wind Westerly.

From the 8th to 14th pressure and temperature varied to a considerable extent. From 8 p.m. on the 7th to 9 a.m. on the 8th the barometer fell 0·7″, followed by Westerly gale, rain, hail, and sleet. The 9th was cold, although there were upwards of 7 hours bright sunshine. On the 10th snow (the first storm of the winter) fell steadily for 14 hours to a mean depth of 6 inches. The maximum temperature was only 28·6°, and the mean 26·38°. At 10-33 minutes p.m. occurred the phenomenon of a palpable earth-shock, the vibration lasting about 5 seconds, and a noise, as of an explosion, was heard in the neighbourhood. On the morning of the 13th snow began to fall, wind changed from North to South, and from 10 a.m. drizzling rain set in, rapidly disposing of the snow, the mean temperature of the 14th being 40·58°. Averages for the week:—Barometer 29·687 in.; temperature 33·26°; sunshine 24 hours 13 minutes: rain 1·286 in.; humidity 87%; wind variable; 6 frosty nights. W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, February 15, 1889.

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The Weather, January 16, to February 15, 1889.

On the 16th of January pressure was rather low all over the kingdom, varying between 29·6 and 29·9 in., and on the 17th it increased briskly to 30·0 in., falling on the 18th in the North to 29·7, though it was as high as 30·4 in the South. It rose again above 30·0 in. on the 19th, and was high and even, 30·2 in., all over the country on the 20th, rising to 30·3 in. on the 21st, and still higher to 30·5 in. on the 22nd, keeping at this height the two following days, but falling to 30·0 in. in the North on the 25th and 30·4 in the South. It increased to 30·1 in. in the North on the 26th, and was 30·4 in. in the South, and was very high on the 27th, being between 30·4 in. and 30·6 in. in all places. It gave way slightly on the 28th, but was still above 30·0 in., and fell very decidedly on the 29th, when it ranged from 29·10 in the North to 29·9 in. in the South, with the isobars running from West to East. It recovered slightly on the 30th, but was falling again on the 31st, and remained low on the 1st of February, with a further fall on the 2nd, when it varied from 28·8 in. to 29·8 in. the isobars still being from West to East. On the 3rd the centre of the depression had passed to the East of Britain but pressure was still low, but rose rapidly on the 4th, and was then above 30·3 in. in the North, but below 30·0 in the South. On the 5th it was high everywhere and continued so on the 6th, though it was a little unsteady, rising in the North and falling in the South, and on the 7th it varied between 29·5 and 29·9 in. A depression in the North on the 8th caused a fall to 28·9 in., but pressure recovered quickly on the 9th, and ranged between 29·5 and 29·7 in. It was between 29·6 and 29·8 in. on the 10th, and much the same on the 11th, but on the 12th it had risen above 30·0 in. in all places. There was another decided fall to 29·6 in. in the North on the 13th, but pressure remained high in the South, but fell to 29·1 in. in the North and 29·5 in the South on the 14th. On the 15th pressure had again increased, and was between 29·4 in. and 29·7 in., the lowest readings being in the East, with the isobars running North and South.

January, 1889.	TEMPERATURE.							RAINFALL.				
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for January,* Daily Max.	Means for January,* Daily Min.	Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Jan.* Ins.
Sheffield ...	54°	18th	21°	6th	38°	—	—	1·54	13	0·48	9th	—
Spurn Head.	50°	31st	25°	5th	39°	—	—	0·70	13	0·24	10th	—
York	55°	18th	23°	7th	38°	43°	33°	1·15	11	0·55	9th	1·88
Barrow	50°	31st	30°	27th	40°	—	—	1·89	15	0·54	29th	—
Liverpool ...	54°	18th	22°	6th	39°	44°	36°	0·72	14	0·12	30th	2·23
Holyhead ...	53°	31st	32°	11th	44°	46°	39°	1·13	18	0·26	9th	3·49
Oxford	51°	18th	20°	7th	37°	44°	34°	0·65	12	0·28	9th	2·33
London	54°	31st	22°	7th	37°	45°	34°	0·96	11	0·25	9th	2·20

* The means of Temperature and Rainfall for January are for 15 years.

From January 16th to 19th (4 days) the weather was very variable, being mild in most places, with strong winds, especially in the North, and the barometer varied greatly, the rainfall being heavy in the West but slight elsewhere. During the week ending January 26th temperature varied a good deal, being high at the beginning of the week but lower afterwards, with night frosts in places, and there was considerable fog, the general conditions being anticyclonic. From the 16th to the 26th rain fell on 8 days at Liverpool, 7 at Barrow and Holyhead, 3 at Spurn and Oxford, and 2 at Sheffield, York, and London. During the week ending February 2nd the anticlyconic system entirely broke up, the air became mild and humid, with showery weather, and there were thunderstorms in several places on February 1st, and strong gales in the North and West. The maximum temperature was in most places as high as 50° during the whole of the week, but night frosts occurred on January 27th, 28th, and February 2nd. There was rain on 7 days at Barrow and Holyhead, 6 at Liverpool, London, and Sheffield, and 5 at Spurn, York, and Oxford. In the following week, February 3rd to 9th, the weather became of a severely wintry character and was very stormy. Gales were experienced, and heavy falls of snow with keen frosts, especially towards the end of the week. Rain or snow fell on 5

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days at Liverpool, Holyhead, and Oxford, 4 at Sheffield, Spurn, York, Barrow, and London. The severe wintry weather of the previous week continued till February 13th, but the wind was not so violent, and on the 14th and 15th the air became mueh milder. From the 10th to the 15th (6 days) there was rain or snow on 6 days at Holyhead, 4 at Spurn, York, Barrow, and Liverpool, and 3 at Sheffield and London.

Sun Spots.

Observations of the sun have been made on 10 days during the month, the other days being unfavourable for observation. On February 4th there was a group of small spots. enclosing an oval space, nearly half way across the disc and a little above the equator. These spots were visible on the 5th, 6th, and 7th, but gradually became smaller and fainter, and had entirely disappeared on the 8th. No other spots have been visible, but the "mottling" of the sun's surface has been remarkably clear on several occasions during the month.

Astronomical Occurrences in March.

The moon is new at 10 p.m. on the 1st, enters its first quarter at 6 p.m. on the 9th, is full at 11-48 a.m. on the 17th, and attains its last quarter phase at 6-54 a.m. on the 24th. It will be new again on the 31st at 11·37 a.m. A fifth magnitude star in Leo will be occulted by the moon on the 15th, disappearing at 2·30 a.m. and re-appearing at 3·4 a.m. Mercury is a morning star, rising an hour before the sun at the beginning of the month, but only 16 minutes before it at the end. Venus is the most conspicuous object in the evening sky, and attains its greatest brilliancy on the 25th. It is in perihelion on the 8th, and is now becoming gradually crescentic in form. It will be in conjunction with the moon on the 5th, and sets at 10-10 at the beginning of the month, and at 10-30 p.m. at the end. Mars does not set until after 8 p.m., but it is an inconspicuous object at present. Jupiter is a morning star, rising at 3·44 at the beginning of the month and at 2 a.m. at the end. Owing to its great southern declination it is near to the horizon. Saturn is visible all night long, and is well placed for observation. It is to the West of the stars in Leo forming the sickle, and is in conjunction with the moon at 6 a.m. on the 14th. The closing of the rings is very perceptible since last year's opposition.

E. Howarth, F.R.A.S.

Museum and Observatory, Sheffield, Feb. 20, 1889.

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Rainfall in Wirral.

We have been favoured by Mr. Reginald Bushell with a copy of his pamphlet, entitled "Twenty-five Years' Rainfall in Wirral," in which is given a valuable series of returns, compiled from all available records, of the rainfall in this district of north-west Cheshire. For a period of over 20 years rain guages have been systematically kept at Frodsham, Willaston, Neston, Bidston, Hinderton, Wallasey, and other places in the Hundred of Wirral. Tables giving the mean results of most of these observations are included, together with an interesting "Note on the Relative Raininess of Different Months," by Mr. G. J. Symons, F.R.S., and an appendix containing useful data upon the "averages" of rainfall, and the "force equivalent" of a rain shower.

The observations which Mr. Bushell has collected and summarized with so much care show that, during the last 27 years, the rainfall in the district under notice has ranged from a maximum of about 45½ inches n 1872, to a maximum of about 21 inches in 1887. The twelve wettest consecutive months were those of the complete year 1872, and the twelve driest were February, 1887, to January, 1888, for which the total rainfall was only 19·37 inches. The range for individual months is from about 7¾ inches to about 1/6 of an inch. On several occasions the downfall of a single day has been sufficient for an average month, and there are others when one very wet month has reached the total of seven consecutive dry ones. To show the uncertainty of rainfall, it has happened that for four or five months together rain has fallen to an average depth of 5½ inches a month, and at other times for six or seven months together, the average has only reached one inch per month.

Some dry summers have only given us 3½ inches of rain from June to August inclusive, and, in other years, as much as 17 inches of rain have fallen in the same period. In 1882-3, out of 243 consecutive days it rained on 175, but in the whole record there is no instance of more than 23 consecutive rainy days or more than 25 consecutive dry ones.

Mr. Bushell laments that, in the matter of rainfall, "nothing seems to be certain but its utter uncertainty." It is only within a comparatively recent period that systematic and widespread observation of the weather has been made, and even now we know too little of the laws governing meteoric changes to be able to forecast rainfall in the manner of certain of the weather prophets. "The greatest meteorologist living," says Mr. Bushell, can no more foretell the rainfall of a single week than he can bind the sweet influences of Pleiades or loose the bands of Orion." We commend this pamphlet to the notice of all who are interested in meteorology, or who care to preserve accurate statistics of the rainfall in parts of our country.

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Societies.

Western Microscopical Club, London.—The monthly meeting was held on 4th Feb. Dr. Lamb opened the proceedings with a well-illustrated and careful exposition of the organ of hearing in man. He then asked Professor Stewart to take up the story as regards the lower animals. The Professor complied, and at once launched into a subject which he has made his own. Whilst in the larger animals we naturally expect to find the ears upon the head, we look in vain for the same arrangement in the lower invertebrate creatures. Many of these, like the scallop, have no head; others, like crabs and lobsters, have their ears placed on their horns or antennæ; others, like the green grasshopper, have the ear on the fore leg; others, like the fresh water shrimp, have it on the tail. In fact, it would seem that in these lower forms of life, whose origin was long anterior to the evolution of man, Nature was feeling her way and making experiments as to the future position of the sense organs. During long ages she was practising and rehearsing on the lower forms before arriving at the fixity of type which marks the structure and position of the ear in man. A very cordial vote of thanks to Dr. Lamb and Professor Stewart was presented through the hon. secretary, Mr. Stokes, F.C.S. Among the non-microscopical exhibits were some remarkable astronomical and storm photographs, shown by Mr. Walker, F.G.S., notably the great photograph of the Andromeda nebula, by Mr. Isaac Roberts, which has created great interest in astronomical circles at home and abroad. Mr. Walker also showed an American photograph of a thunderstorm, in which the cloud-scape is wholly embroidered with an incredibly beautiful network of electricity. This last was taken by Mr. Binden, of Boston, Mass., and kindly presented by him to the exhibitor.

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The Craven (Yorkshire) Naturalists' Association.—At the meeting of this association, on Monday, the 11th February, Mr. H. Bendelack Hewetson, of Leeds, gave a lecture on "The Eye in Man and Animals." He said it was a mere compliment, in speaking of the eye, to place man before animals, for he had never yet known a human eye perfect in all its parts, as shown in class-books; while in almost everything for which it was supposed to be specially adapted it was equalled and surpassed by the eye of some animals. A striking instance of this was the long-sightedness of birds—the butcher bird, for instance, showing itself, after repeated trials, capable of discerning a coming hawk seven minutes before it was visible to the human eye—

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a most astonishing acuteness of perception, only paralleled by the power of scent possessed by a bloodhound, which could track a bicycle-wheel stroked by its master's hand through the streets of a crowded city. The lowest forms of animal life were found to be sensitive to light, and to be affected by it; and in such as possess no eye the effect seemed distributed over the whole body. The effect of nerve action was shown by the power fish possessed, when transferred from a dark to a light pool of water. So also with gold-fish and frogs. Birds showed the same, a wonderful instance being that of the sand grouse, which had recently, it was to be hoped, determined to settle amongst us. He had studied these birds since they first appeared here from the Asiatic deserts, and they were rapidly changing their sandy colour to a darker one, in keeping with "dirty England." The lecturer next drew attention to certain peculiarities in the eye of the chameleon and the horse, and then proceeded to describe the human eye—its various parts and their uses, the causes of long and short sight, and the remedies to be adopted—incidentally remarking that though it was popularly supposed that short-sighted people were able to give up their spectacles in advancing years, yet this was contrary to experience, the change being too slight to produce much effect. He explained what was meant by astigmatism, first studied by the Astronomer-Royal, and said that it was more common than most people supposed, many eyes being, so to speak, more short-sighted in one plane than another, so that in looking at a church window, for instance, lines at one angle might appear better defined than those at another. The cause of myopia, or short-sightedness, was referred to, and this had been attributed to reading much; but, after careful study, he had concluded that this was not the case, for it existed in animals; and in the aborigines of the South Sea Islands—very little removed from cannibalism—myopia was very prevalent. Lastly, he explained the nature of cataract as an opacity of the lens, which assumed various forms, and occurred in infants at times, it was conjectured, by the use of teething powders containing mercury. The recent introduction of cocaine had enabled surgeons to operate on the eye without the slightest pain or inconvenience to the patient. The lecture was fully illustrated by diagrams and black-board sketches, and attracted a large audience.

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Leeds Naturalists' Club and Scientific Association.—The opening meeting of the above club for 1889 was held on the 4th February, in the Library of the Philosophical Hall, Park Row. There was a large attendance of members. Dr. H. Pendelack Hewetson, M.R.C.S., introduced Professor De Burgh Birch, M.D., C.M., F.R.S.E., the elected president for the current year. Professor Birch then took the chair, and gave an address on "Low Forms of Life: Industrial, Putrefactive, Pathological." Dr. Jacob described the organisms which he was exhibiting under the microscope. These were bacillus tuberculosis, which is the cause of consumption; also germs of leprosy, anthrax (known as woolsorters' disease), of abscess, and others. Mr. Branson showed a number of lantern slides of bacillus and other organisms on the screen. Mr. George Hainsworth exhibited the yeast plant, and Mr. John Stubbins, F.R.M.S., F.G.S., actinophry eichornii. At the meeting held on Monday, the 11th Feb., Mr. John Stubbins, F.G.S., F.R.M.S., vice-president, in the chair, Miss Josephine Brunton, and Messrs. Gilbert Middleton, John E. Westerman, Walter Green, and Ed. Thompson were elected members. The evening was arranged for "general exhibits." In reference to a lecture on the subject of mimicry given before the club a short time ago by Mr. Cash, of Halifax, there were now shown by the chairman a small case of bees which he had received from the well-known entomologist, Mr. Fred. Enoch, of London. These were arranged by the side of a corresponding number of other insects, which had taken to themselves certain notable features of resemblance so as to pass for and even delude the actual bees. The bees shown and the insects they are mimicked by were—

Bees.	Insects.
Apathus vestalis (psithyrus).	Votucella pellucens
Bombus lapidarius.	var. V. bombylans.
B. Muscorum.	var. V. bombylans.

Mr. Phillips, who occupied the chair later in the evening, showed Polypodium vulgare. Mr. Boulton showed a microtone, which he had just completed, adapted for cutting sections by the paraffin and celluloidine process. The instrument was well finished, and had all the appearance of usefulness. Mr. W. Kirkby exhibited a large and valuable collection of plants, some ninety in all, from France, Norway, Switzerland, and New Zealand, giving several interesting notes on certain peculiarities of the plants and of their actual or allied occurrence in British botany.

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Liverpool Marine Biological Committee.—Active work was carried on at the Puffin Island Station in February. Some of the members worked in the laboratory and on the shore. Professor Herdman started a series of observations on the "Zoning" of the shore, or the arrangement of the shore between tide-marks into a series of bands, each characterised by the presence or absence of particular plants or animals. Mr. I. C. Thompson gave attention to the Copepoda; Mr. R. J. Harvey Gibson to the Algæ; and by these and others many good specimens were collected, some new to the local list. Several students and others intend to go to the station for work in April.

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Liverpool Biological Society.—The fifth meeting of the current session was held on February 8th, at University College. Mr. R. J. Harvey Gibson brought forward a proposition relating to the preparation of periodical reports upon recent advances in biology. This admirable suggestion was adopted in the hope that younger members of the society would be induced to take up some special branch of study. Professor Herdman exhibited specimens of *Chelyosoma*, a rare ascidian, and an Old Red Sandstone fish, *Pterichthys*, which have been recently compared. He showed that the supposed resemblance is only superficial and of no value. Mr. George Brook, F.L.S., of Edinburgh, next read a paper on "Dimorphism in the Antipatharia." After giving an account of the general anatomy of an ordinary form, such as *Cirripathes*, he showed that in *Antipathes* the individuals are elongated in the direction of the septa bearing the reproductive organs. Then, in *Leiopathes*, a form recently found near Naples, this elongation is more marked, and a septum or fold cuts off the reproductive portions of the zooid from the nutritive portion. Further: in *Schizopathes* and *Bathypathes*, the separation is complete, and the nutritive zooids are distinct from the reproductive ones, though they still retain their triplet form (R.N.R.R.N.R.) Dr. Larkin then exhibited an ingenious model, which showed a simple schema of the lymphatic circulation. The president read the "Report on the Diatomacea of the Liverpool Bay,' drawn up by Dr. Stolterfoth, in which 184 species are enumerated, 47 not having been previously recorded in the district. Mr. H. C. Chadwick's "Report on the Echinodermata of the Liverpool Bay" was next read, and 5 species new to the district were given It is remarkable that all these were obtained near Port Erin during the "Hyæna" cruise of 1888. Dr. Hanitsch presented a "Report on the Sponges of Liverpool Bay," mentioning 47 species, 7 being new to the district and one new to Britain. Dr. Ellis exhibited an insect, *Sirex juvencus*, found boring in a larch, from the South of Scotland.

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Liverpool Entomological Society.—The annual meeting of this society was held in the Free Library, William Brown Street, Mr. Samuel J. Capper presiding. The officers for 1889 were re-elected as follows:—President, Mr. S. J. Capper, F.L.S.; vice-president, Mr.

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F. N. Pierce; secretary, Mr. R. Wilding. The secretary, in his annual report, stated that the number of members was now 54, and that there remained a small balance in hand, after defraying all expenses. The president, in a lengthy and interesting address, gave a *résumé* of the work done during the year, and congratulated the members on the continued success and prosperity of the Society. Among the more interesting subjects from a practical point of view under discussion were those relating to lepidoptera, economic entomology, and the Hessian fly, which were respectively dealt with in the following terms:—"The past year was a favourable one for the lepidopterists. Early in the spring I was informed by several correspondents that larvæ were remarkably abundant. This was especially the case in the New Forest. Mr. Gulliver stated that he never remembered a season when they were so plentiful; but he also said that their enemies, ichneumons, were also in great abundance. Messrs. Adye and Druitt confirmed this in a communication made to the *Entomologist* in July, wherein they state that, on entering a wood near Holmsley, New Forest, their attention was called to the bareness of the foliage on the oak trees, whilst the trunks were completely surrounded with webs, within and on which there were swarms of larvæ of several different species. The leaves were completely stripped from the boughs except at the tops of the trees. The caterpillars also occurred plentifully, resting on the bracken fern; and by listening there could be heard a distinct rustling of larvæ crawling amongst the dead leaves on the ground. The editor of the *Entomologist* adds:—'There has been in many districts a like abundance this season of lepidopterous larvæ, feeding especially on oaks. In some parts of Epping Forest and in Surrey and Kent trees look as naked as in mid-winter.' Though lepidoptera generally were abundant, the season, I think, was less remarkable for rarities than usual. *Catocala promissa* and *sponsa* fairly swarmed, and *Apatura iris* was more than usually abundant. But the event of the year is the abundance of *Deilephila Galii* larvæ. In the year 1870 the larvæ of this beautiful species were taken in great abundance on our Wallasey sand hills, and also in many other parts of the country, viz., Leominster, Chepstow, Birmingham, Derby, Nottingham, &c. In economic entomology much has been accomplished during the past year, and last year's work has shown a steady advance in the sound and serviceable attention given to subjects bearing on the prevention of ravages by farm insects; and there is a great desire abroad for solid information such as could not fail to be of much service in advancing agricultural entomology. The early part of the year was remarkable for observations of several kinds of insect attacks, which have either not been recorded before as injurious to crops in England, or which were much more injurious than has previously been observed. The bean-weevil, *Bruchus rufimanus* (the *B. granarius* of Curtis), was prevalent, and quite unusually injurious in various localities in the south and east of England; and much harm was also caused by various kinds of larvæ feeding on or in the stems of the young corn-plants. Of these the larvæ or maggots of the Frit-fly, the *Oscinis Frit*, did great damage to young oats in Devon and Cornwall, and at localities across the country in a line towards Norwich. The maggot of the wheat bulb-fly, the *Hylemia coarctata*, was also very injurious over a large area. Early in the year great damage was caused, especially in some parts of Hants, by a coleopterous larva, which fed on the young wheat. This was certainly a geodepphagous larva; and, so far as the excessively-difficult matter could be managed of identifying a beetle grub when only a quarter grown, it appeared to be the larva of *Zabrus gibbus*. The Hessian fly showed a most satisfactory decrease in amount of reported presence; and the very important subject of Warble prevention has advanced greatly during the past season. Miss A. E. Ormerod, to whom I am indebted for what I have said respecting economic entomology, has been as indefatigable as ever in this, her life-work. She has just kindly sent me a short handbill, which is being extensively circulated amongst the farmers and graziers in Great Britain, stating that the loss annually through the Warble fly to the country is from £3,000,000 to £4,000,000. One half of the fat beasts in this country are afflicted with this grub, all of which might be saved if the fly attack in the summer were prevented, which might easily be done by destroying the maggots. This may be effected by squeezing them out, or they may be killed by putting a dab of cart grease and sulphur, M'Dougall's smear, or anything that will choke them in the opening of the warble."

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Liverpool Literary and Philosophical Society.—Amongst other subjects dealt with at a meeting of this Society, on February 18th, Dr. Murray Moore read a paper on "Bones of the Extinct Moa, and Spheria Caterpillar, with Fungus Developed from its Head," and gave a very interesting account of the plant growing from the head of the caterpillar, and showed a well-preserved specimen of the insect and fungus.

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Liverpool Field Naturalists' Club.—The annual meeting of the members of this club was held on 26th January, at the Royal Institution, the Rev. H. H. Higgins, president, occupying the chair. The report of the 28th session, which was presented by Dr. J. W. Ellis, hon. secretary, congratulated the members upon the increased success which had attended the operations of the club during the past year—a success which had been shown not only by the larger attendance at the field meetings, and the greater competition for excursion prizes, but also by the active interest in the newly-inaugurated evening meetings for beginners, which had been one of the principal features of the session. The club now numbered 324 members, a large number of resignations having been nearly counterbalanced by the election of new members. The sum of £12 9s. 6d. has been awarded in excursion prizes. The financial statement showed a satisfactory balance in hand. The report and statement of accounts were adopted. The officers and committee were elected, and after the president had distributed the prizes gained during the session he delivered an address, entitled "Luminosity."

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Liverpool Science Students' Association.—At the February meeting—Mr. Osmund W. Jeffs, president, in the chair—some interesting notes on "Artificial Illumination Under Scientific Conditions" were read by Mr. H. Ashton-Hill, Assoc. M.I.C.E., after which a paper was read by Dr. J. R. Logan on "Microbia: a General Account of Minute Organisms." The author described the various divisions of micro-organisms—as the yeasts, micrococci, bacteria, and bacilii—and referred to their size, shape, and general appearance, and gave details of the methods of the cultivation of the germs for scientific purposes. The lecturer, in the course of his remarks, maintained that, as cows are very liable to consumption, it was imperative that dairies should be placed under competent inspection, in order that the contamination of the milk, which he asserted occurred, should be prevented. Lantern transparencies and diagrams, prepared by the author, were used to illustrate the subject.

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Manchester Conchological Society.—At the meeting, on the 6th December, Mr Edward Collier exhibited a number of shells, including some nice forms of Pisidia from various localities around Manchester; *Sphærium lacustre*, *var. Brochoniana*, from Clumber; *Helix rufescens*, *var*, *minor*, from Kirby Lonsdale; and *Helix aspersa* from Aberystwyth, which had been accidentally damaged whilst immature, and afterwards completed, but without epidermis or colouring matter, showing that the colouring glands of the animal had been injured. He showed some peculiar forms of *Limnæa palustris* from a pond at Clayton-le-Moors, all with much deeper suture than usual,

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and rather inclined to be scalariform, or disunited in the whorls. Some examples of American Unios, or freshwater mussels, were exhibited by Mr. Collier, and he pointed out the varying shape of the shells of male and female individuals. Some interesting discussion respecting the bi-sexuality of this particular group of bivalves took place. It is now generally accepted as indisputable that some shells are male and others female. The shapes of the males and females, especially in the Unio perplexus group, are so dissimilar that no persons unacquainted with the subject would be disposed to consider them the same species. The variation in shape is due to the eggs in the female filling the whole extent of the outer gill—in some instances, as has been computed, to the number of six hundred thousand at once. ——At the February meeting of this society Mr. Edward Collier, who occupied the chair, exhibited a collection of small land and freshwater shells from the Society Islands, received from the late Mr. Garrett, including some nice examples of endodants, omphalotropis, tornatellina, and truncatella, and the specimens, though minute, were well displayed by the new method of tube-mounting which Mr. Collier had employed. Mr. Thomas Rogers showed a number of large bulimus from the Philippine Islands, illustrating the forgeries practised by the natives, who collect showing shells for sale to travellers and traders in natural curiosities. To improve the beauty of the reddish-brown land shells shown, they mark them artificially, in a most skilful manner, by some unknown method. Mr. Rogers suggested that the curious markings and mottlings were done by the application of a hot iron to the epidermis of the shell, and not by the use of acids or other means usually employed by dealers to improve upon nature in the case of the showy species imported into this country as mantel ornaments. Mr. M. R. Standen exhibited some rare and curious land shells from Pegu and Burmah; specimens of shells from Lake Corangmite, Victoria; *Limperegra* of a peculiar labiate form from near Burnley; and *Helix rohindata var. alb.* from Wales. Mr. Charles Oldham showed some specimens of freshwater shells collected last season in Cheshire, and the scarce *pupa ringens*, from Elkswood, Ingleton.

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The Lower Mosley Street Natural History Society, Manchester.—The meetings of this society are held weekly, and during a recent period the following papers have been read :—"The Emperor Moth" (*saturnia pavonia*), Mr. J. Watson; "Expedition from the Sydney Museum to Lord Howe Island," Mr. Thomas Rogers; "Comparative Respiration in Animals," Mr. Henry Hyde; "Generation in Insects," Mr. F. Saulden; "Rosaceæ," Mr. W. J. Payne; "The Krakatoa Volcanic Eruption," Mr. William Horsfall; "Geological Notes," Mr. Theodore Sington. The following are some of the exhibits :—Myrtle in fruit, Mr. W. J. Payne; collection of plants from Tiflis, Mr. John Johnson; orchids (including *Odontoglossum rossi* and *O. majus*), Mr. J. Watson; foraminifera (chiefly from the "Challenger" expedition) and a number of drawings of the same, Mr. William Chaffers; sections of plant tissues, Mr. Hy. Hyde; seeds of orchids, Mr. W. J. Payne. The society does not possess a large number of members, but all are workers, and during the summer, botanical, geological, and other excursions are made in the district.——At the ordinary weekly meeting held on Monday, the 11th February, Mr. Thomas Rogers in the chair, Mr. J. Watson read a paper on the "Development of Platysamia Cecropia," a North American silk-moth. Mr. Watson's remarks were based upon personal observations, he having reared the moth from the egg and watched its growth in almost every possible stage. The paper was illustrated with diagrams, eggs of the moth larvæ in spirit, living pupæ, cocoons, and a specimen of silk on a reel, which Mr. Watson had taken directly from the mouth of a living larvæ when in the act of "spinning." Mr. J. Cosmo Melvill sent for exhibition an extensive collection of plants, both British and European, belonging to the genus plantago. Some of the European species were very remarkable in form, and differed considerably from those met with in this country.

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Manx Natural History and Antiquarian Society.—At the meeting held on the 6th December some discussion arose as to the proposed publication of a magazine, which was deferred. It was also announced that a geological survey of the island was arranged for, to be under the direction of the Director-General of the Survey of Great Britain. The following communication was read by Dr. Haviland for the author, Mr. J. E. Bedford :—

Flint Flake Implements found on Peel Hill.

About a year ago the writer had an opportunity to examine some sections of gravel and sand on the hillside opposite to Peel Castle. The material was much cross-bedded, and it was difficult to determine whether it was a raised sea-beach or an old river-terrace. The beds are at different elevations on the hillside and within a few yards of the present sea margin, and about the same distance from the estuary of the stream or river running into the harbour of Peel. The rock forming the base is clay-slate of Lower Silurian or Cambrian age, dipping at a high angle. Lying upon this rock is a bed of gravel three or four feet thick, then a layer of sandy loam, and upon this about ten or twelve inches of surface soil with vegetable remains. The sandy loam appears to be a rain-wash accumulation with vegetable matter; also the darker-coloured surface soil, with roots of heather, &c. The beds lying upon the gravel contain great numbers of flint flake implements, consisting of knives, scrapers, spear-points, arrow-tips, and pointed instruments for various purposes, such as piercing skins, bone, horn, &c. Cores and waste flakes were found along with the finished tools. The greater number were found at different depths in the surface soil, from three inches to twelve inches down; a much smaller number were got from the underlying bed of sandy loam, and these had a much older appearance; the flint had become white and opaque in its substance, and an ochreous deposit had formed on the surface. The depth at which the latter were found varied from eighteen inches to two feet. The flints have been classified as follows :—200 flint tools and weapons; 181 broken implements and flakes which had been rejected, but all showing design; 15 nuclei or cores; 66 sundry chips—a total of 462. The flints found are all of the same type of manufacture (although they must differ considerably in age), and from the fact of cores being found along with them they were probably made on the spot. The situation of the hill leads one to believe it to have been long frequented by man. It rises to a considerable elevation direct from the sea, and forms a good point for observation over sea and land, and commands the rocky island on which Peel Castle is built. The writer was unable to determine the source of the flint nodules. They are ordinary grey flint from the chalk, but, as no chalk strata occur on the island, it is difficult to say where they come from, unless they exist in deposits of boulder clay, drift, or gravel. They would in this case be found washed out on the beach. The nearest point at which they could be obtained from the chalk *in situ* is the Irish coast, no more recent rock formation than carboniferous limestone existing in the Isle of Man. A close examination of the flint cores finally settles one point of the question—they were not got from the chalk *in situ* and imported into the island. Most of the cores show a portion of the original outer surface of the nodule, and in all cases it is water-worn and weathered to a considerable depth from the surface. Minute cracks or fractures are seen, caused by concussion in rolling to and fro, and striking one against another when beaten by the surf on the sea-beach. If the flint had been procured direct by mining in the chalk the nodules would have presented quite a different appearance, the peculiar shape of flint nodules recently obtained from the chalk being well known. Many of the implements are good specimens of early flint-making, some of the pointed instruments having no doubt required very careful manipulation to produce them, they are so small and delicate. Taking the collection as a whole, one is struck with the rude and primitive type of the weapons. They are simple flake tools, and do not show any signs of snipping into shape after the flake was struck off. Not a single specimen of a barbed arrow-head was found, nor yet showing any attempt at grinding into shape. The general type of the flake will be recognised on referring to "Ancient Stone Implements of Great Britain," by Mr. John Evans. The figures 200, 233, and 397 therein given are average samples, but the edges are untrimmed.

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Nottingham Naturalists' Society.—At the bi-monthly meeting of this society, held on 12th February, Mr. B. Sturges Dodd, vice-president, in the chair, Mr. E. Kidson read a paper on "Further Traces of Glaciation in Snowdonia." The paper opened with a short description of the effects produced by glaciers, special reference being made to Switzerland. A detailed account followed of the evidences of of glacier action in North Wales, which the lecturer had noticed during a number of visits, the description being confined to the part of the country near Snowdon. It was pointed out that the Idwal Valley,

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ten miles south-east from Bangor, is exceedingly rich in the marks it bears of having, at some remote period, contained a glacier. From the Ogwen Falls at the mouth of the valley, the moraine *débris* extends to the foot of the cliffs, which form its boundary on the south-west. Almost exactly at the outlet of Lake Idwal there is a collection of moraine matter, which was no doubt deposited as the climate became warmer. From this spot moraine heaps can be seen on both sides of the lake, extending as far as the great line of blocks coming down from the gap known as the "Devil's Kitchen." About two miles from this chasm is the head of the celebrated Pass of Llanberis. A considerable body of ice must have passed over this spot, for only a few yards away there is an exposure of the moraine *débris*, showing it to be fully 20 feet thick. The lecturer stated that close to this spot he had traced the glaciation marks to a height of over 2,000 feet above sea-level. In the Pass of Llanberis the groovings on the rocks show that the ice flowed roughly towards the north-west, that being the direction of the lie of the valley. Of the tributary valleys, the most remarkable on the flanks of Snowdon is Cwm Glas, the entrance of which is three miles or so from Llanberis. Its mouth appears to be blocked by a large *roche moutonnée*, and on either side of this are little streams, which have cut their way through the moraine *débris* now forming their banks. In no place in the district is the glaciation so striking as in this little valley. The paper was illustrated by lantern slides and rock specimens.

THE LIVERPOOL CHEMISTS' ASSOCIATION.—This association commenced its fortieth session when the annual meeting was held at the Royal Institution, Colquitt Street. The president, Mr. A. H. Samuel, occupied the chair. After the transaction of formal business, the secretary, Mr. J. S. Ward, read the report, in which the council announced that the amalgamation of the late Liverpool Registered Chemists' Trade Association with this association had proved very advantageous, strengthening the association numerically, and extending its sphere of usefulness by bringing it into closer communion with the chemists and druggists of the city generally. The hon. treasurer presented his annual statement, showing a balance in hand of £16 16s. 11d. Mr. A. H. Samuel, F.C.S., was re-elected president for the ensuing session. The report and statement of accounts having been confirmed, the following gentlemen were chosen to serve on the council:—Messrs. A. C. Abraham, F. J. Mackinlay, R. Parkinson, J. J. Smith, W. R. Smith, R. M. Sumner, and T. Williams.

YORKSHIRE COLLEGE SOCIETY OF CHEMISTS AND COLOURISTS.—A meeting of this society was held on Thursday, the 7th of February, in the Dyeing Lecture-room at the College, Professor Hummel (the vice-president) in the chair. Mr. C. H. Bothamley, F.C.S., assistant lecturer on chemistry, gave a lecture on "The Chemical Effects of Radiation." The ancients, he said, were well acquainted with the fact that many coloured substances alter and fade when exposed to light; but it was not until the eighteenth century that experiments in this direction began to be made, and since that time observations have gradually been accumulated. As a matter of fact, there are very few substances which do not alter more or less when exposed to light; salts of silver lose part of the acid which they contain; salts of iron or mercury pass from a higher to a lower state of oxidation; bitumen and many other organic substances oxidise and become insoluble in certain solvents; mixtures of potassium bichromate with gelatine, starch, and other organic substances rapidly undergo change. Many of these changes are constantly utilised in photographic processes. The old idea that a beam of light contains three perfectly distinct kinds of rays—namely, light rays, heat rays, and rays which produce chemical changes, and were called "actinic" rays—is quite erroneous. What we generally speak of as "light" is really a sensation which has no existence *as light* apart from ourselves. The cause of this sensation is energy, which originates in the rapidly-moving particles of luminous bodies, and is transmitted through space by means of the ether in the form of undulations or waves, which differ in wave length and in period of vibration. These waves constitute what is known as a "beam of light," and the sensation called light is the result of their impact on the retina of the eye. One and the same ray may produce luminous, heating, and chemical effects. For example, there are certain rays which, if they fall upon the eye, produce a sensation of blue light; if they fall upon a surface of lamp-black they produce heat; if they fall upon a photographic plate they produce chemical decomposition. It is an established principle that a substance can only be affected by those rays which it absorbs. In all cases the effect, whatever it may be, is due to the communication of the energy of the waves to the particles of the substance on which they fall. The exact nature of the effect depends upon the nature of the substance and the conditions under which it is placed. Whether a substance will or will not absorb a particular ray depends upon whether the vibration of the particles of the substance corresponds with the vibrations of the ray, just as a tuning-fork will take up the vibrations of another with which it is perfectly in unison. The result of the transfer of energy from the waves to the material particles is to throw the later into such energetic vibration that the atoms of which they are composed are frequently shaken asunder, and are free to arrange themselves in the form of new compounds according to the chemical actions existing between them.

LIVERPOOL ENGINEERING SOCIETY.—The sixth ordinary meeting of the present session of the Liverpool Engineering Society was held on 9th January, at the Royal Institution, Colquitt-street, the chair being occupied by Mr. Charles H. Darbishire, Assoc. M. Inst., C E., the president. There was a large attendance of members. The routine business having been transacted, Mr. A. W. Brightmore, M. Sc., read a paper on the "Application of Atmospheric Air to Produce Motive Power." After giving a short account of the thermodynamics of gases, Mr. Brightmore showed that the efficiency of a steam engine was limited by the loss of temperature between the gases in the furnace and the water in the boiler. Some hot-air engines were open to the same objection, and others that had not this defect lost efficiency by insufficient expansion. In the gas engine—a species of air engine, the working substance being air, to which heat was applied in the most direct manner by the combustion of the gas—the amount of expansion obtained was greater than in the air engines. The gas engine, therefore, worked between wider limits of temperature, and was consequently more efficient than either the steam engine or the hot-air engine.

GEOLOGICAL SOCIETY OF GLASGOW.—The fourth meeting of the 31st session was held on Thursday night, 12th Jan., in the Society's Rooms, 207, Bath Street, Mr. Daniel M'Millan, vice-president, in the chair. Mr. Walter Burns exhibited specimens of intrusive dolerite from Loch Ranza, Arran, and sandstone with dendritic markings from John o' Groats, Caithness. Mr. D. C. Glen, F.G.S., also exhibited a number of specimens of sandstone slate, and flint, showing these curious branching forms, and an interesting discussion as to their origin and occurrence followed. Mr. John Young, F.G.S., exhibited under the society's microscope sections of a small hydrocoralline organism new to western Scotland, *Micheldeania Nicholsoni* from the limestones of Trearne, Beith. In the course of his remarks Mr. Young said that the fossil under notice was so named from having been first found at Micheldean, in the Forest of Dean, England, some three years ago. He had now to record its occurrence at Trearne, where it is found somewhat sparingly in one of the thin polyzoal bands of the limestone. In structure it resembles to some extent that

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of *Millepora*, one of the hydrocorallinæ, but with smaller tubes and more dense wall structure. Two species have now been found in Scottish carboniferous limestones, the other species being *Michelinia gregaria*. Mr. Mathew Blair read a paper on "The Surface Geology of Paisley," in which he gave an interesting account of the boulder clay, brick clay, Arctic shell, clay peat, and alluvial soil of the district. The paper was illustrated by diagrams and specimens of rocks and fossils. A horn of *Bos primigenius*, which had been dug up from a depth of 14 feet, was also shown. At the meeting in February, Mr. Dugald Bell, vice-president, in the chair, several gentlemen were proposed as ordinary members. Mr. Henry M. Cadell, B.Sc., F.R.S.E., of Grange, late of H.M. Geological Survey of Scotland, read a paper entitled "Recent Advances in the Study of Mountain Building, with Special Reference to the Structure of the North-West Highlands." The author explained that amongst most of the geologists who had of late years been engaged in investigating the structure of the North-West Highlands, and especially amongst those who did not concur in Sir Roderick Murchison's explanation of the phenomena exhibited there, it was a growing belief that great overthrusts had been largely instrumental in producing the remarkable stratigraphical relations of the rock masses of that region. It had, therefore, occurred to him, and to some of his colleagues in that Survey, after studying these great problems on the spot, that experiments might be made to throw light on the work by seeking to imitate in the laboratory the processes they believe to have been in operation in the North-West Highlands at an ancient geological period. He had accordingly instituted a series of experiments on these lines, and they were attended with great success, the structures obtained having a marked similarity to those observed in the field. With the aid of numerous diagrams, sections of strata, and geological maps, Mr. Cadell, on this occasion, brought before the meeting the results of a number of the experiments previously made, and to make more clear the *modus operandi* he showed, by using layers of coloured sand and other materials, the very curious results of lateral pressure applied to strata originally horizontal.

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Liverpool Geological Society.—The meeting of this society, held on Tuesday, February 12th, was one of considerable interest, as dealing with the nature of the district from which the future water supply of Liverpool is to be obtained. The subject was brought forward by Sir James A. Picton, F.S.A., in a paper entitled "The Vyrnwy Valley: its Geological and Glacial History," and the paper was supplemented by some very interesting details and observations communicated by Mr. G. F. Deacon, M.Inst.C.E., the engineer in charge of the works, to whom is due the inception of the scheme. The river Vyrnwy (in Cymric, rapid stream) rises on the southern slope of the Berwyn mountain range, which divides the basin of the Dee from that of the Severn, and after a course of about 20 miles (omitting the windings) it falls into the Emion, an affluent of the Severn. The range above the head waters of the river rises to a height of 2,100 feet. The valley, which is to be the site of the future Lake Vyrnwy—the reservoir from which the water supply of Liverpool will be drawn—is nearly 5 miles long and about half a mile wide, rising from a flat, marshy strath, through which the river winds to a series of rounded heights on both sides. The strata forming the basin belong to the upper and lower Silurian system, being composed of hard, cleavable schustose rock, with few fossils, and dipping from east to west at an angle of about 20 degrees. The alluvial flat in the valley at the bottom of the hills is composed of alluvial gravels and sand, which, according to the author of the paper, and also in the opinion of the engineer, occupy the site of a glacial lake, which owes its origin to the action of a glacier descending the valley. A barrier of hard rock, upon which the present masonry dam is built, served on the retreat of the glacier to impound the waters and to constitute the lake, which has since been filled up by the deposits brought down by the river. In these alluvial deposits there occurs no fragment of rock foreign to the valley, thus proving the local origin of the deposits. The position of the rocky barrier was ascertained by numerous borings and shafts, and when the great trench across the valley was built and the rocky floor exposed, not only were beautiful examples of smoothed, rounded, and striated surfaces disclosed, but (as was shown by drawings) the manufacture of boulders was exhibited. Huge masses of rock, some hundreds of tons weight, were seen displaced, in some cases only a few inches from their original position. Evidences of glacial action are to be seen also in the character of the eminences surrounding the Vyrnwy Valley, which show that peculiar rounded form called in Welsh *moel*, or baldheaded. The natural fracture of the schistose rock would be sharp, angular, serrated, such as we find round the skirts of Snowdon, at Tre Vaen, and the Glydyrs. The present outline of the summits is rather that of the *roches moutonnées*, or polished rocks, on a larger scale, giving that soft and pleasing outline so dear to the landscape painter. On the sides of the valley are found moraine deposits containing boulders from outside the drainage area. The length of the lake or reservoir when full will be 4¾ miles; breadth on the average half-a-mile, surface area 1,121 acres, and the extent of the gathering ground in the Vyrnwy Valley and in the adjoining valleys of the Afon Cowny and March Nant, 23,2000 acres. The height of the surface above the point of delivery at Liverpool is about 600 feet. The estimated supply under the present arrangement, deducting 10,000,000 gallons per day for compensation water (as required by the Act of Parliament), will be 13,000,000 gallons, while, when all the projected works are carried out, the supply will be increased to 40,000,000 gallons per day. The aqueduct by which the water will be conveyed to Liverpool will have a length of 77 miles. The water of the lake is at the present time in course of being impounded. The preliminary business of the meeting included the passing of resolutions, proposed by Mr. O. W. Jeffs, to the effect that a special committee be formed to investigate into the occurrence, character, origin, and transport of boulders, or "erratic blocks," in the neighbourhood of Liverpool, and their bearing on questions of glacial geology.

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Liverpool Geological Association.—The monthly meeting of this association was held at the Free Library, William Brown Street, on the 4th February, the vice-president (Mr. T. R. Connell) in the chair. Mr. E. M. Coffee having been elected to membership, the discussion on Mr. Percy F. Kendall's address on "The Geology of Mull," adjourned from November meeting, was taken up by Messrs. Hornell, Lomas, Davies, Hewitt, and the secretary (Mr. I. E. George). In Mr. Kendall's reply much valuable information was given as to the structure of igneous rocks and the conditions under which volcanic action had taken place in the Western Isles of Scotland.

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Geological Society of London.—On 6th February, a paper was read by Professor J. Prestwich, F.R.S., on the "Occurrence of Palæolithic Flint Implements in the neighbourhood of Ightnam, Kent: their Distribution and Probable Age." Over 400 implements had been discovered over a wide area around Ightham. A description of the physiography of the district and of the distribution of the various gravels and drifts was given, and, in the absence of fossils, attention was called to the different levels at which the deposits occurred. Besides the river gravels, two groups of unclassed gravels were described, one occupying a low level and the other occupying levels higher than that to which the river drifts reached. It was shown that the high level deposits were formed anteriorly to the post glacial drifts of the Medway and Thames valleys. The paper was discussed at some length by Dr. Evans, Dr. Hicks, Messrs. Topley, Whitaker, Allen, Brown, and Harrison.

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Manchester Geological Society.—A special meeting of the Manchester Geological Society was held on 28th January, at Owens College, Alderman John Knowles, president, in the chair. The new Beyer wing of the college was thrown open to the members. Mr. Leader Williams, C.E., gave a short address on the progress of the Ship Canal works. He also exhibited some interesting specimens from triassic sandstones found near Runcorn. Professor Boyd Dawkins briefly described the additions to the geological and zoological museums of the College during the year, and Mr. Percy F. Kendall read a paper on the volcanic phenomena of the Island of Mull. His paper was illustrated by diagrams and lantern slides, showing a number of rock sections. Finally Professor Boyd Dawkins conducted the members through the museums.—At the February meeting of this society, Mr. Thomas Oldham read a paper on "The Cause of Earthquakes, of the Dislocation and Overlapping of Strata, and of Similar Phenomena." Mr. Oldham advanced a theory of his own with regard to the centrifugal force exerted by the rotation of the earth upon its axis to account for seismic phenomena and the overlapping of strata in the earth's crust. The author's views were opposed by several members present. Mr. Percy F. Kendall, Assistant Lecturer on Geology at Owens College, read a paper on the Oxford Street boulder, now deposited in the quadrangle at the College. Much information has already been communicated to the public on the subject of the boulder. The object of Mr. Kendall's present communication was to point out certain peculiarities which were not observed at first, and to correct one or two errors which had been made in the description of the beds in which the stone was found. The great boulder lay with its long axis in a horizontal position and directed about S. 18deg. E. mag., and it was completely enveloped in boulder clay. The bottom of the mass was three feet below the general level of the surface of the gravel bed. It had obviously been dropped down when a few feet at most of the clay had been deposited, and by the violence of its descent had driven three or four inches before it down into a hollow impressed in the underlying gravel to a depth of three feet. In a note previously read to the Society he spoke of the rock as an andesite. In this he was confirmed by an analysis, which had since been made for him by Dr. Cohen. He had been favoured by a specimen and section of an andesite rock of very similar character from Southwaite, Cumberland, and a comparison with this and other Lake District lavas induced him to qualify his formerly-expressed opinion regarding the place of origin of the boulder, and to content himself with the vague and general localisation to the Lake District. Describing some of the external features of the boulder, and pointing especially to evidences of fracture (caused, he believed, by concussion previous to its glaciation), Mr. Kendall ventured the explanation that the boulder lay upon a hillside exposed to the weather, and thus acquired its present ferruginous crust; that at some period in the glacial epoch it was dislodged by an avalanche, and, thundering down from crag to crag, fragments were struck off from its surface. Falling upon the surface of a glacier, such as the great ice stream which came down Ennerdale, it in course of time dropped down a crevasse, and, gradually making its way to the bottom, was scrubbed over the rocky floor of the glacier bed and acquired the scratches now seen upon it. As to its mode of transport to its resting place in the boulder clay, he inclined to the opinion that it was carried by an ice sheet the greater part of the way from the Cumbrian hills, and the remainder of the distance by a floating berg, from which it fell into deep water. This appeared to be indicated by the distance to which the stone was driven into the boulder clay and the underlying gravel. Mr. De Rance made a brief reference to the earthquake shock which was felt throughout a great part of Lancashire on Sunday night. He mentioned the singular fact, in connection with the earthquake which visited Essex two or three years ago, that in some deep wells the water level was raised, and it continued at the higher level for some months. His object in mentioning the matter was to ascertain, if possible, whether any similar phenomenon had been observed to follow the earthquake in Lancashire.

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Liverpool Microscopical Society.—The second meeting of the 21st session was held at the Royal Institution, on Friday, Mr. I. C. Thompson, F.L.S., F.R.M.S., president, in the chair. A paper was read by Dr. Frederick C. Larkin, the subject being "The Skin, Healthy and Diseased," which was illustrated by a large number of transparencies, shown by the oxyhydrogen lantern. Afterwards the usual *conversazione* was held, when a number of interesting microscopical objects were exhibited. On the evening of February 14th the president of the Society (Mr. Isaac C. Thompson, F.L.S., F.R.M.S.), and Mrs. Thompson, gave in the Royal Institution, Colquitt Street, a *conversazione* to which members and their friends were invited. Invitations were responded to by the majority of the members and their lady friends to the number of about 200, and also several representatives from University College and other scientific societies. About fifty microscopes were exhibited by various members of the Society, including several by Dr. Larkin, of University College. Amongst the other interesting exhibits was a large collection of microphotographs and views, taken by Mr. F. T. Paul, F.R.C.S., and kindly shown by him with the aid of the oxyhydrogen lantern. The Rev. H. H. Higgins contributed several interesting natural history objects from the Museum; Mr. A. Norman Tate a large variety of lantern slides, &c., and some remarkably perfect fossil fish were lent by Mr. Charles Potter. The new picture galleries in which the *conversazione* took place were prettily adorned with exotic plants, shrubs, and flowers, which aided in producing a very pretty and pleasing effect. The microscopical subjects included specimens from the mineral, vegetable, and animal kingdoms, all of which attracted much attention and were very much admired. Among the accessory attractions shown were the latest editions to the Mayer collection. These were not classed among the microscopical subjects, though they might very well have have been, because it takes a magnifying glass of considerable power to discover all their beauties. The specimens are in the one instance a cast-iron necklace, and in the other a similar production in very fine work, both being of marvellous delicacy. Another loan from the Mayer collection was a small case of luminous insects, &c., which were also subjected to minute scrutiny, and carefully explained by the Rev. H. H. Higgins, who had them under his especial charge. The necklaces had attached to them the following description:—"Necklaces in cast-iron and wire work, made at Berlin for the ladies who gave up their jewellery to be made into coin for the payment of the troops in the Franco-German war."

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Barnsley Naturalists' Society.—On the 21st January Mr. S. A. Adamson, F.G.S., secretary to the Leeds Geological Association, delivered a lecture upon "The Work of the Yorkshire Boulder Committee." He stated that Barnsley was a fine field for observation of the nature required by the committee, and he desired to enlist the aid of the members. Throughout the county geologists had responded with enthusiasm, and whilst during the British Association meetings at Manchester in 1887, and at Bath in 1888, no fewer than eighty-two reports were presented from Yorkshire, the committee had already at least forty more for presentation at the Newcastle meeting this year. Mr. Adamson then spoke at some length upon boulders, or, as they are geologically termed, erratic blocks, and dwelt upon the geological importance of obtaining the exact facts respecting their distribution. Erratics, comprising large blocks of granite, gneiss, traps, mountain limestone, &c., are scattered over the west and east coasts, and the northern and midland counties of England. These boulders can generally be traced to their source, and when we find that a large

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number of boulders can be thus traced to a given area or point, the point of their origin is called a centre of dispersion. This distribution of these boulders gives much light on the subject of the motion of large sheets of land or floating ice. Mr. Adamson then described the following centres of dispersion, with the paths of the boulders derived therefrom, with specimens of the characteristic rocks :—The Criffel, the Eskdale, the Arenig, and the Shap Fell centres. These were also illustrated by large maps, and the map of the Yorkshire Boulder Committee, with the positions of the boulders reported upon to the British Association, was also shown. Mr. Adamson gave further several descriptions of notable boulders, not only to familiarise his audience with them, but also that they might visit them for their own inspection. Amongst others were described the famous one of Shap granite at Seamer, those on the Yorkshire coast, those in Teesdale, &c., and a lengthened account was given of the magnificent group at Norber, near Clapham. The enormous terminal concentration of Criffel boulders (intermixed with a few Lake District rocks) near Wolverhampton, about fifteen miles in length and about four miles in breadth, which the lecturer had visited, was likewise described.

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Liverpool and District Association of Science and Art Teachers.—The above association met on Saturday, February 9th, in the Liverpool Institute. The president (Mr. W. Hewitt, B.Sc.), presided. Messrs. R. C. Lindsay, B.Sc., F. J. Routledge, J. J. Egan, Edwin Zachary, and H. Entwistle were elected members. The president's address on "The Function of Natural Science in Primary Education," read at the last meeting, was discussed, and replied to by the president. A short discussion followed on the "Report of the Liverpool Association for the Promotion of Technical Education."

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Liverpool Polytechnic Society.—At a meeting held on 12th February, Mr. B. H. Thwaite, C.S., lectured on "Crude Hydro-Carbons as Heating and Lighting Agents." In the course of his remarks he referred to the various improvements which have been made during the last few years in the application of oil to the generation of motive power in every form of machinery, and also to its value as a means of producing a powerful light for open air work.

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Liverpool Science Club.—On 17th January, Professor Carey M.A., lectured on "Celestial Effulgences." Those mysterious bodies known as shooting stars, meteors, and comets were dealt with very fully, the chief interest of the lecture centring, however, on that flight of shooting stars known as the Leonids. The last brilliant display from the vicinity of the constellation of the Lion was in November, 1866, and the next will be in November, 1899, for this shower has a period of 33 years. This time is slowly changing, owing to causes which were fully illustrated by means of blackboard drawings. The history of the Leonids and the views of the moon in regard to shooting stars, were reviewed ; and strange stories were told in regard to the superstitions of ancient races about the fiery bodies which gleamed at times in the sky. The investigations of Adams, in England, and of Leverrier, in France, in connection with shooting stars were detailed, and the latest theories in regard to these little-understood bodies were also given. An interesting discussion on the subject brought the meeting to a close.——A lecture was delivered in connection with this club, in the Library and Museum buildings, by the Rev. F. F. Grensted, M.A., of Merchant Taylor's School, Crosby, the subject being "What is an Atom?" The lecturer carefully explained the latest theories and investigations as to the probable nature of the ultimate atom by the leading scientific men of our day, and also traced back the recorded investigations of the great philosophers of the past. A large amount of information was condensed into the lecture, which was concluded by a lantern exhibition of some specimens of solar-spectrum photography, the work of Mr. George Higgs, of Tuebrook, who has done much practical work in this direction.

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Manchester Microscopical Society.—At the ordinary meeting of the Manchester Microscopical Society, held on Thursday evening, the 7th February, Mr. E. W. Napper, F.C.S., one of the vice-presidents, in the chair, Mr. Napper brought for exhibition a very old microscope, which was interesting as showing with what inferior lenses, as compared with those in use at the present day, our predecessors produced such good results in scientific work. Many of the so-called modern "improvements" were seen in an imperfect form on this instrument, which must be at least one hundred years old. Mr. Brain, of Great Yarmouth, sent specimens of the skin of the dog-fish for distribution, and Mr. Wilkes showed them under the microscope. Mr. Thomas E. Hoyle exhibited and explained a new form of polarising prism (Ahren's), which he had fitted to an Abbé substage condenser of English make. He said that this prism gives a very large field, and by its use a greater portion of the angular aperture of an objective can be utilised. Mr. Percy F. Kendall, assistant lecturer in geology at Owens College, gave a communication on devitrification. This he described as a physical change taking place in volcanic eruptive rocks, which are at first of a vitreous or glassy composition, whereby their vitreous character is partially or completely destroyed by the development of microliths, crystalline granules, or crystals. Mr. Kendall illustrated his remarks by a valuable collection of rock sections, and these were projected upon the screen by means of the oxyhydrogen lantern by Mr. Leech, who used an Ahern's prism, mentioned by Mr. Hoyle, to obtain the polarising effects. On this evening an old custom was revived, the meeting resolving itself into a *conversazione* for the exhibition of new and interesting microscopic objects.

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Bath Photographic Society.—The first general meeting of this society was held recently at the Royal Literary and Scientific Institution, Mr. Austin J. King presiding. The Chairman, in his opening remarks, explained how the society had originated during the meeting of the British Association in the city. A small committee had been appointed to frame the rules of the society, and it would be very hard to over-rate the assistance they had received from their hon. sec. (Mr. W. M. Ashman). The president (Mr. Pumphrey) gave an address on the early processes of photography, with especial reference to daguerreotype. These, he said, were hardly known at present. If we go back to the earliest times when a photographic effect was produced, it would be in the days of Wedgewood and Herschel, when it was found that certain silver salts become reduced by the action of light, when in connection with organic bodies, into a form of oxide. Wedgewood obtained photographs by coating white leather with a solution of silver. He (the speaker) was not aware that paper entered into his experiments. That was the real starting point, and from that date until now, with one great exception, namely, that of natural colours, processes had been introduced and so modified that something like perfection was reached. In 1814, at Chalon sur Laône, Nicephore Niepce was engaged in experiments with silver iodide, which he carried on for a considerable time with very little result. The first images produced in the camera were by Daguerre. He was not a chemist, neither was he an optician. He was a scene painter. How strange it should be that he was led to examine the action of light on silver. This was about 1829. Finding Niepce working in the same direction, and to avoid clashing with each other, they became partners to carry out the invention of producing photographic images by light. Ten years after the process of Daguerreotype was published, the French Government granting to Daguerre a pension of 6,000 francs, and to

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Niepce 4,000 francs. Owing to the then state of patent law in this country, Beard patented the process in England, and held it for several years, so that all who practised it had to get a license. The President then described the details of manipulation, and concluded by handing round several examples of work dating from 1846.

THE NEW YORK MICROSCOPICAL SOCIETY.—In the annual address to this society the president, Mr. Charles F. Fox, dealt with "The Spontaneous Generation Theory, and its Relation to the General Theory of Evolution," and in the course of an elaborate and eloquent discussion of the several views that have from time to time been put forward with regard to evolution, he endeavoured to show—(1) That a transition from not-living matter to living forms is an essential step in the process of evolution. (2) That at the point at which experimental proof is applicable (namely, to present and continual archebiosis) the theory of such a transition is discredited, if not disproved. (3) That scientists generally accept this conclusion, and that those who are thorough evolutionists are confined to the mere belief that the step from the not-living to the living was taken at some remotely early period, beyond the reach of evidence. And he submitted that, as a consequence of these premises, the general theory of evolution is still in the stage of *hypothesis*, and that in the gap between lifeless substances and living forms we have the veritable "missing link."

MANCHESTER TECHNICAL SCHOOL.—The new branch of this school, in which it is intended to give instruction in spinning and weaving, was formally opened by Mr. Chancellor Christie, on February 12th. The new school has been constructed out of the old Swedenborgian Church and Schools in Peter Street, and has been thoroughly equipped for the work intended to be there carried on. The whole of the spinning machinery has been given by Messrs. Dobson & Barlow, of Bolton, and Messrs. Robert Hall & Sons, of Bury, have given the preparation machinery and two or three special looms, and looms and other appliances have been given by Messrs. Atherton Brothers, Messrs. Dugdale & Sons, Messrs. Henry Livesey, Messrs. Wm. Smith & Bros., Messrs. Stubbs & Co., and Messrs. Stott & Co. The High-Sheriff, Mr. Oliver Heywood, president of the Technical School, was in the chair, and in the course of his remarks said that in the limited space in Princess Street only members of evening classses could have the advantage of receiving instruction in spinning and weaving, but in the new building day classes would be opened and will be helpful to those, whether managers or foremen, to whom a knowledge of the theory and practice of cotton manufacturing might be useful. There are to be courses of instruction extending over two years, spinning and weaving, theoretical and practical, will be taught, and lecture courses open to youths of mills and workshops will be given. All this has been made possible by the liberality of the legatees of Sir Joseph Whitworth. The number of students in the classes this year was 3,040, as against 2,617 last year. Mr. Chancellor Christie afterwards, on behalf of himself and co-trustees under the will of the late Sir Joseph Whitworth, handed over to the Council of the Technical School the use of the building.

Review.

Liverpool Marine Biological Committee. Second Annual Report on the Puffin Island Biological Station. By W. A. Herdman. [Liverpool, 1889.]

THIS report gives an admirable account of the work done at this newly-organised station of the Liverpool Biological Committee. Advantage of the station was largely taken by students during the spring and summer months of 1888, with the result that a great mass of material has been collected, and a good measure of practical work carried on. Dredging and tow-netting operations have also been regularly prosecuted, and the efforts of the biologists in this direction have been well rewarded by the capture of one or more species new to the district, and several species entirely new to science. Unfortunately, the small steam launch met with a series of mishaps which prevented full use being made of it, and it is about to be replaced by a more suitable form of boat. Amongst those who have done scientific work at the station during the past year are Professor Herdman, Messrs. Harvey Gibson, Alfred O. Walker, W. R. Melly, R. M'Millan, I. C. Thompson, and Dr. Hannitsch. We congratulate the committee on the high character of the results obtained, and cordially wish the station success in the future. Mention should not be omitted of the cover of the Report, which is embellished by some pictorial designs showing the island, the biological station, and the dredging operations of the now famous "Hyæna." A chart of Puffin Island also accompanies the Report.

New and Forthcoming Works on Science.

BAILLIERE & Co., London, announce the issue of two Maps, by Dr. Alfred Haviland, of Douglas, illustrating the geographical distribution of Phthisis and of Cancer in England and in Wales.

MR. J. P. EARWAKER, M.A., F.S.A., has issued a limited edition of an 8vo. volume of 190 pages, on the recent discoveries of Roman remains found in repairing the north wall of the City of Chester. The work is profusely illustrated, including twenty full-page plates.

CROSBY, LOCKWOOD & SON, London, announce the publication of a new edition of *The Blowpipe in Chemistry, Mineralogy, and Geology*, by Lieut.-Colonel W. A. Ross, R.A.; and *Tables and Memoranda for Farmers, Agricultural Students, Surveyors, and others.*

PROFESSOR R. MELDOLA has completed his work on *The Chemistry of Photography*, which will shortly be published by Messrs. Macmillan and Co.

The Story of the Heavens, the popular astronomical handbook, by Sir R. S. Ball, is being re-issued in a cheaper form by Messrs. Cassell & Co.

Practical Elements of Construction is the title of a useful handbook on methods of surveying, published by Messrs. Elliott Stock & Co. Price 6s.

MR. E. A. BUTLER'S new edition of the *Young Collector's Series*, issued by Messrs. Swan, Sonnenschein & Co., deals with "Silkworms" in a very interesting and attractive manner. Price 1s.

A PRACTICAL treatise on *Electric Bells*, by W. S. R. Bottone (Whittaker & Co., London. 3s.), is to be recommended to all those who have to do with the troubles me and not seldom unsatisfactory operation of fitting electric bells.

MESSRS. LONGMANS, GREEN & Co. announce the publication of a *Handbook of Cryptogamic Botany*, by A. W. Bennett, M.A., &c., and George R. Milne Murray, F.L.S. 378 illustrations, 8vo., referred to in our notes on forthcoming works in our September issue. No general handbook on this subject has appeared in English since Berkeley's, published in 1857. Also, *An Elementary Theory of the Tides*, by T. K. Abbott, B.D., in which the fundamental theories are to be demonstrated without mathematics.

AMONGST the announcements of Messrs. Macmillan & Co., we notice: *Elementary Statics*, by the Rev. J. B. Lock, M.A.; *Questions and Examples on Elementary Physics—Sound, Light, Heat and Electricity*, by Benjamin Loewy, F.R.A.S.; *A Practical Text-Book on Pathology*, by Professor D. J. Hamilton; *Bacteria in Asiatic Cholera*, by Dr. E. Klein, F.R.S.; *Modern Views of Electricity*, by Dr. Oliver J. Lodge, F.R.S.; *Popular Lectures on Physical Science*, by Sir William Thomson; *Microscopical Physiography of Rock-forming Minerals*, by H. Rosenbusch, translated by H. P. Iddings; *Darwinism*, by Alfred R. Wallace, F.R.S.

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An Electric Megascopp.—In the optical lantern and the projecting apparatus usually employed, transparent slides have to be used. It can be easily imagined how useful it would prove to have a method of making projections of opaque objects, such as photographs affixed to cardboard, medals, and various apparatus of small dimensions. The physicist Charles introduced into lecture courses an apparatus called the megascope, by means of which the projection of opaque bodies was effected. The objects placed outside of a dark room were brilliantly illuminated by the sun; and a lens properly fixed in the shutter projected an enlarged image upon a screen. An artificial light was soon substituted for the sun; and at the beginning of the present century the effects produced by the megascope had considerable success. The use of the apparatus was not confined to the projection of statues, bas-reliefs, and medals upon a screen, but was extended to the projecting of living persons, who were strongly illuminated by Argand lamps. Since that epoch, numbers of megascopes have successively appeared. We shall now make known to our readers an electric apparatus constructed by M. Trouvé under the name of the anxanoscope. This apparatus, which is lighted internally by means of one or two small incandescent lamps, is very useful for projecting photographs, drawings, medals, &c. It consists of two cylindrical tubes, fitted together at a certain angle. One of these tubes is provided at its upper part with a lamp and parabolic reflector; and the other contains an ordinary photographic objective. At the angle formed by the union of the two tubes is placed the object to be projected by reflection on the screen, say a landscape, a photographic portrait, or a chromolithograph. The most remarkable projections are those of medals and coins, and especially the works of a watch in motion. There is another model made which differs from the one just described in the addition of a second cylinder containing another electric lamp placed in the focus of a second parabolic reflector. A bichromate of potash battery of four elements, or a battery of Bunsen cells, may be used for supplying the incandescent lamps.—*Photography.*

Obituary.

Mr. T. A. Readwin, F.G.S.—We regret to hear of the death of this well-known geologist, which took place, after a long illness, at Trawsfynydd, Merionethshire. Mr. Readwin, who was in his 71st year, will be held in special recollection for his efforts in developing the gold-mining industry in Wales. Probably no one was so well acquainted with the history of the gold supply of Britain, and his various papers contributed to the Manchester Geological Society and to the Geologists' Association of London were always both interesting and valuable.

Letters to the Editor.

The Formation of Dew.

Birmingham, February 13th, 1889.

Dear Sir,—I have been very much interested in reading Dr. McPherson's two able articles in your valuable paper on the "Formation of Dew;" but is not the writer wrong in saying that "the drops that hang diamond-like on the leaves and flowers on a summer morning are not dewdrops at all, but are only the exudation from the veins of the healthy plant?"

Now, the most elementary student of vegetable physiology knows that transpiration, or the giving off into the atmosphere of water by the stomata of leaves, takes place when the air is warm and dry (which is usually in the daytime), and that when the atmosphere becomes charged with moisture and the temperature becomes lower (which is usually at night in summer), little or no transpiration takes place, the cells of the leaves become "turgid" with moisture, *which is absorbed from the atmosphere.* The dew (I cannot call it by any other name), which is moisture absorbed from the soil and vegetable organisms during the daytime, condenses on all objects alike when the air becomes cooler at night, but the presence of the characteristic dewdrops of the poet on living leaves is due to the presence of millions of tiny hairs that cover the leaves of nearly all plants, and entangle the minute particles of water from the air, which is again absorbed into the atmosphere when the sun becomes more powerful, together with the moisture taken up by the roots of the plants and given off by transpiration.—I am, Sir, yours respectfully, John Collins.

[Substitute "evening" for "morning," and there can be no doubt whatever of the truth of the statement; but, even as it is in the article, the globules which are produced by the vital action of the plant before the evening will not have evaporated before morning,—Ed. *Research.*]

Mr. Harvey Gibson's "Elementary Biology."

Sir,—With regard to the remarks of the reviewer of the above work on the summaries of the principal conclusions of the inorganic sciences, I think, if he carefully reads the preface, he will see that it is expressly stated that the summary is "intended to be suggestive rather than exhaustive." I also think that the reviewer is mistaken about what he calls the author's "fascination for multiform terminology." Mr. Harvey Gibson throughout his book has used the same terms in describing the reproductive organs of both plants and animals, although, of course, it was sometimes necessary to refer to the terms used in other books. It seems to me to be hardly within the scope of an elementary text-book to give "instructions as to the best means of procuring, preparing, and manipulating the subjects," as such instructions would much increase the size of the volume, and are to be found already fully set forth in other books, such as Bower's "Practical Botany," and "The Frog," by Milnes Marshall. I am sure that nothing was further from the author's thoughts than "to do away with the necessity for the student seeing and investigating for himself." For instance, in the note on page 29 we read—"It is to be distinctly understood that a memory knowledge of the characters of the substances entering into the composition of protoplasm is of little value unless coupled with a practical knowledge gained by actual observation and experiment in the laboratory."

As a student, may I be allowed to say that I entirely disagree with the opinions of the reviewer relating to burdening the mind of the reader with theories and speculations? Far from the student finding his mind burdened with theories and speculations, I think that they are of the greatest help to him in connecting facts together and recalling them to his mind. If a student simply learns the bare, well-established facts unconnected by theory, he is apt to learn a string of facts like a parrot, without reflecting on their connection and significance, while he acquires a sort of vague impression that he will know all about it after a year or two more of study. On the other hand, a theory obliges him to observe carefully and note certain facts on which the theory is based. It seems to me to be as much the duty of a teacher to tell his students of what is unknown or uncertain, as what is known; while, by telling them of the best-established and most generally-accepted theories, he guards them from the danger of picking up exploded or absurd theories from some old or unscientific book, and prevents the pernicious habit of learning without thinking, showing them, at the same time, how vast is the field of science.

Of course it is needless to say that I do not advocate the study of theory without facts and practical work, but I do contend that theories and hypotheses are of the greatest possible help to the student, giving life and organization to what would otherwise be a shapeless mass of unconnected facts.

In conclusion, I must say that it seems to me that the aim of education should be, not to make walking encyclopædias, but thinking, reasoning, inquiring beings; and I am sure that in a scientific education, that end is best obtained by a judicious mixture of theory and fact.—Yours faithfully, May Rathbone.

[*Note by the Editor.*—We regret that we have not space to print in full the long letter received from Miss Rathbone, but the above is an abstract of all the chief points, and to allow the matter to be fully discussed we have sumbitted the letter to the Reviewer of Mr. Gibson's work, who sends us the following: -

Note by Reviewer.—With reference to Miss May Rathbone's criticisms of my review, I wish to say:—

1. By careful perusal of the review the points *re* "principal conclusions of the inorganic sciences" will be found to be answered.

2. The *intention* of the Author in respect to terminology is commendable, but the introduction of "multiform terminology" in this *Elementary Text-Book*, which is obvious on almost every page, serves no useful purpose.

3. The Reviewer was perfectly aware of the many very excellent "practical books," and is also aware that it is an objection for a "beginner" to be working with three or four books on the same subject, when one might well be made to suffice. If much of the "theoretical" had been excluded from the Author's work, room might have been found for the more useful matter referred to by the Reviewer.

4. Whatever is said on the subject of "theory *v.* fact" in biological science, the practical and experimental must ever hold the first position. The honoured Darwin could labour for upwards of *thirty years* before he presumed to give to the world the far-reaching and magnificent theory of the "Origin of Species." Sir John Lubbock never tires of patiently prying into the multiplied contrivances of Nature. The writer presumes that theory obliges the student to "observe carefully," to "weigh evidence for and against." This is the dream of the student, not the experience of the teacher. Nothing is more inimical to progress and thoroughness than for a beginner in biological science to have his mind filled with theories. He must be made to feel the necessity of getting a foundation of *facts*, and through this the labyrinths of theory will follow soon enough.]

Notice to Correspondent.

Old Geologist has not conformed to our rules (see front page), but if he will send name and address (not necessarily for publication) his criticisms shall receive careful attention.

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Research:

A MONTHLY ILLUSTRATED JOURNAL OF SCIENCE.

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NOTICES.

☞ *Owing to the large number of reports from scientific societies in different parts of the country, and other communications received, we this month find it again necessary to add four pages to our Journal.*

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & Co. Price 3d., or by post, 4d. Annual Subscription 3s., or by post, 4s.

Remittances for Subscriptions should be made payable to E. O. WINDEL, care of C. Birchall, 32, Castle Street, Liverpool.

Remittances and Communications respecting Advertisements, should be addressed to C. BIRCHALL, 32, Castle Street, Liverpool.

Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of news and important additions to their colle ctions.

Communications intended for insertion in the followlng numbers hould reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th

Life Insurance.

IN another column of this issue will be found a communication on the subject of scientific men and insurance, to which we would draw careful attention. Life insurance should be of interest to all classes of the community, and to no persons can it be more advantageous than to science workers, many of whom are professional men, receiving fees or salaries dependent entirely upon their own individual work. And in many walks of scientific life the remuneration is by no means large, and many young men, ambitious to make a name for themselves, occupy positions in colleges and other establishments at a rate of payment quite insufficient, if they marry and have families, to allow them to save up, except in the course of many years, what can, in case of their death, afford a comfortable competence for those they leave behind. As a result, appeals for assistance for the families of deceased scientific men are very frequent. No doubt these appeals are often generously responded to, as they should be, but in many cases this outside help would be unnecessary if judicious use of life insurance were made. By it there is assured at once an amount in case of death which might take years to put by out of ordinary savings.

The very many plans of effecting insurance, either for the whole term of life or for an amount payable at some specified age, or on previous death, with the several ways in which the premiums can be paid, offer every possible facility not only for the very prudent and desirable procedure of making provision for those left behind when death occurs, but, also if an endowment policy is taken out, for assuring a certain amount of income to the insurer himself at a certain fixed age.

The endowment policies are probably those best suited for the scientific or professional man, for whilst during the period of active work it may be comparatively easy to pay premiums regularly, at a later period it is well to be able to feel that all has been paid, or even that the fruits of the payments can be made practically available.

But every plan of insurance is advantageous and the whole subject is one of vast importance, and we earnestly hope that this communication and the few lines we have now written may induce some of our readers who may not yet have insured, but who have others dependent on them, to most carefully consider their position and make use of the advantages that life insurance offers.

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Glimpses of the Unseen Universe by the aid of Photography.*

By Isaac Roberts, F.R.A.S., F.G.S.

THE universe, about which I shall endeavour to address you this evening, is in the boundless space which surrounds the earth, and consists, as far as our present knowledge extends, of a sun, planets, satellites, comets, stars, and nebulæ. The two latter, the stars and nebulæ, will occupy chiefly our attention this evening, and in order to justify the title of this address I shall first briefly glance at the celestial objects which have already been seen, though seen only by a limited number of persons, and then show some of the latest extensions of human vision by the aid of photography.

Let us for a moment look back in time 280 years (1610), when the most learned men were content to know that the earth was the centre of the universe and the sun and stars subsidiary to it, and, having no optical aids, their eyes would enable them to count some 3000 of the stars, and these, together with the earth, would be to them the extent of the universe as then known. But a change was at hand, for Galileo had invented a telescope—a marvellous instrument that showed vastly greater numbers of stars, and also that some of them presented strange appearances. The telescope was only a little one, about the size of this (shown), but much inferior in quality. With it he saw the lunar craters, the satellites of Jupiter, the ring of Saturn, the phases of Venus, the spots on the sun, and many other marvels of the sky, which up to that time had formed parts of the unseen universe, and were quite unknown previously to mankind. During the centuries that have passed away between the time when Galileo lived and the present, the developments of the telescope in perfection and in power and size have, as we all know, been very great, and since the time of Sir William Herschell (1780) the improvements have proceeded by leaps and bounds; but, as it is not a part of my subject this evening to sketch the history of astronomy, I shall limit my references to a few of the very large telescopes which are of recent construction, and then place before you delineated records of some of the revelations concerning the unseen universe which by their aid have been made manifest. Sir William Herschell was the first to construct a reflecting telescope of the large aperture of four feet and 40 feet focal length. It was completed just 100 years ago, in 1789, and by skilful and untiring energy in using it till he was upwards of four score years of age, he brought to the knowledge of mankind a vast number of the secrets of the unseen universe. The great Herschell telescope was followed by one still larger, made by the Earl of Rosse between the years 1822 and 1845. The speculum is six feet in diameter and 54 feet focal length.

Our illustrious townsman, the late William Lassell, constructed a reflecting telescope of 4ft. aperture and took it to Malta, where he observed with it close double stars, nebulæ, planets, and their satellites.

Mr. Newall, at Gateshead, has a refracting telescope of 25in. aperture, made by Cook, of York, and it was the first of this class that was made up to the year 1870.

Since 1870 the large telescopes, both of the reflecting and refracting class, have been rapidly multiplied in several countries. One is erected at Melbourne, another at Nice, and another at Vienna. In America are several large refractors. The latest and by far the largest of them is at Mount Hamilton, in California, and was presented to the nation by the late James Lick. The object glass is 36in. in diameter and 46ft. focal length. The floor of the observatory is, by hydraulic power, made to either rise or lower to suit the observer's convenience at the telescope.

* A paper read before the Literary and Philosophical Society of Liverpool, Monday, March 18th, 1889.

All the telescopes to which I have so far referred are constructed for observing celestial objects with the eye directly applied to them; but during the past five years another class of telescope has been constructed for exclusively photographic application. At present, or, rather, until the end of last year, only two such telescopes of large size were in existence. One of them, a 13in. refractor, was made by the Brothers Henry for the Paris observatory; and the other, a 20in. reflector, was made for me by Sir Howard Grubb, of Dublin.

We have now considered with sufficient detail, for the present, the gigantic and costly instruments that have, with the utmost ingenuity and perfection, been constructed with the object of wresting some of the hidden secrets of the unseen universe, so as to reveal them to us and thereby increase our knowledge. We will now pass on to examine some of the records concerning the secrets themselves, as they have with the greatest care and labour been presented to us by the several eminent astronomers who have spent most of their lives in using the instruments for this purpose.

The evidence which they have left to us will best be appreciated and understood if I show you on the screen drawings of some of the objects as they were made by eye observations with the large telescopes, and, by contrast, show the same objects as they are now revealed to us by the aid of photography.

Catalogues of stars and nebulæ have been made by many astronomers, both ancient and modern, and the largest modern catalogue was made by Argelander, the great German astronomer, at Bonn, between the years 1852 and 1862. The telescope he used for the work was only about 3in. aperture, and by its aid he charted 324,000 stars in the northern hemisphere of the sky.

On the screen I show the 38 stars he charted within one degree of the North Pole, and concurrently show on the second screen the 1,270 stars which I charted in the same sky space, by photography, in one hour. Also the 94 stars Argelander charted on four square degrees of the sky in the constellation Vulpecula; and on the other screen the more than 16,000 stars I charted, in three hours, on the same space in the sky.

It is apparent, even on casual inspection, that the power of registering the positions, numbers, and magnitudes of the stars with accuracy is now in our hands; and we may further assert that it is so for the first time in the history of our race. But, great as the advance is in the method of charting the stars by photography, there is another of as great importance in the delineation of nebulæ—a class of celestial objects that has hitherto remained a puzzle to all astronomers, notwithstanding the closest scrutiny and study by the aid of the gigantic instruments that have been made to examine them. The nebulæ have, by spectrum analysis, been proved to be gaseous—to consist of various gases in a hot, glowing state; or else, as Mr. Lockyer has recently suggested, of solid particles of matter colliding against each other in space with such force that they are pulverised and converted into a glowing gas, with the result that we are enabled to see them and analyse them by aid of the spectroscope. Laplace long ago (1799) speculated that of such stuff the sun, the stars, and all worlds are made; and the evidence obtained by photography is rapidly accumulating during the past two or three years, which tends to prove, like spectrum analysis, that the nebular hypothesis will probably soon be capable of demonstration. But I am anticipating a little, and must now draw your attention to the nebula shown on the screen. It is known as the dumb-bell nebula in Vulpecula. When drawings of this nebula, made by William Lassell, at Malta, and by Trouvelot, with the 26in. refractor, at Harvard College, U.S.A., are contrasted with my photograph, it is seen that the photograph shows much more truly the constitution of the nebula.

Another nebula that has been closely studied by many astronomers is the great Orion nebula. Many drawings have been made of it, but

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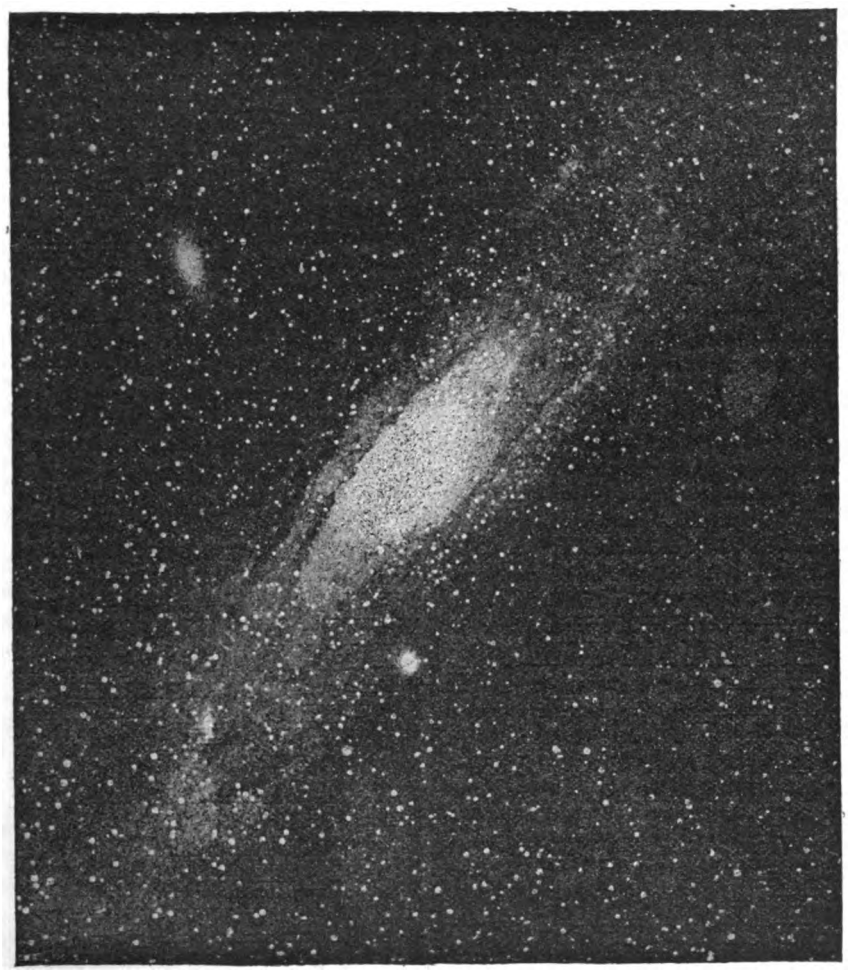
the most elaborate is that by Lord Rosse, with the six-foot reflector, which occupied in its preparation "every available hour during several seasons." When this drawing is compared with my two photographs —one exposed for 81 minutes and the other for 3½ hours—the objects appear quite different, and the photograph shows a vast extention of the nebula.

The group of stars known as the Pleiades has been scrutinised by all the astronomers possessing large telescopes; but only in a vague, disputable manner has it been by some asserted and denied by others that they saw some nebulosity amongst the group, though the Merope nebula is easily seen.

Three centuries ago men believed the universe to consist of some 3000 small bodies called stars, and that they were subsidiary to the earth. One century ago—nay, even thirty years ago—few astronomers would have ventured to teach that there were more than 20 millions of stars in existence, and the most eminent astronomers of the present day would, so recently as four years ago, not have felt themselves justified in asserting that the great telescopes could show more than 50 millions; but now that the photographs, some of which you have just seen, show more than 16,000 stars on the small space of four square degrees of sky—a space that would be covered by a sixpenny-piece held out at arm's length from the eye—it is easy to calculate and



THE GREAT NEBULA IN ANDROMEDA. *From a Photograph by Isaac Roberts, F.R.A.S., &c.*

Professor Weiss, of Vienna, who observes with the 27-inch Grubb refractor, prepared a drawing of what he saw, or thought he saw, as nebulæ. The drawing contrasted with a photograph shows no resemblance.

One of the best known of the nebulæ is the great nebula in Andromeda, which on a clear night appears to the naked eye as a small patch of diffused light. Many drawings of it have been made, but that by Trouvelot is the best of them; but this again shows little resemblance to what is depicted by photography. The photograph shows a solar system in course of evolution.

You can now, I trust, form some idea, though it may be vague, of the stellar universe, and probably the widening out of our conception of its vastness will have impressed you most powerfully.

then to infer, with considerable confidence, that there are at least 170 millions of stars. And when we have brought ourselves to realise this probability, fortified as it is by photography, that the longer we expose a plate to a clear sky—even where not one star is visible to the eye-sight—the greater is the number of stars imprinted upon it, then what is more natural than the inference that the stars are strewn over the infinite space as thickly crowded as if we were looking at a cloud of dust, of which the particles are innumerable.

We know there is a limit to the number of particles in the dust cloud; but who shall say that there is a limit to the stellar universe? What are the myriads of stars we now know to exist? They are not worlds, for they are intensely hot masses, like the sun, and are at distances so great that the nearest to us yet found amongst them is 225,000 times greater than the distance of the earth from the sun.

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Each one of them may be larger than the sun, and each one may be the centre and governor of a system of planets or worlds, and each world may be the colony of some forms of life; but these are, at present, speculations, and man may never be able to demonstrate the truth of them. But with our ever-increasing powers of observation and ability to obtain and preserve for future correlation accurate records of the positions and magnitudes of some millions of the stars, our successors in the near future will be able to deduce from them the laws that govern the movements of the sun and the stars—for they are alike, every one of them, in rapid motion—so as ultimately to reduce what now appears to us like chaos to such order that the course in space of the star-suns, as well as our solar system, will be known, and the astronomers of the future will watch each star-sun leading his train of planets round about their gigantic orbits, where one revolution may occupy millions of years in its accomplishment, with the clearness that we can now watch the revolution in 365 days of the microscopic speck of dust man proudly calls the earth.

The nebulæ also may be watched from the gaseous state to the state of solidification, and new worlds be seen to be evolved from material air. All these and more are now conceived to be possibilities of the future, though millions of years may elapse before man can demonstrate them. But if Hipparchus, in the year 128 B.C., had been able to photograph the sky as we now can do, what marvels and mysteries should we now be able to unravel! But vain is regret. Our work is to make the records in the present so that our successors on or before the year A.D. 3889 will be in possession of some of the grand secrets which we are only permitted to enjoy in anticipation and in hope.

Aerial Navigation.

SINCE the discovery of the balloon by the Montgolfier Brothers, in 1782, a variety of peculiar contrivances have been ingeniously constructed with a view to producing a machine, not merely capable of raising and falling in a vertical line like the balloon, but one that would travel from any one given point to another whilst suspended in the air. The difficulties of accomplishing this have, so far, proved insuperable. But who, in this nineteenth century, would dare to say that anything is impossible after witnessing such discoveries of modern invention as the phonograph, telephone, and telegraph? One, therefore, judiciously refrains from pronouncing judgment. The impossibilities of to-day are the possibilities of to-morrow. The latest sensational exploits in aerial flights by parachutes have done little or nothing, however, to solve the question of artificial transit after the manner of the bird. One of the most eminent students and experimentalists of the day on the subject—J. Bell Pettigrew, M.D., F.R.S., R.C.P.—furnished the now defunct *Fraser's Magazine* with an exhaustive and able article on man's aerial flight about eight years ago. Space forbids its reproduction here, but the writer is indebted to the before-mentioned article for many useful suggestions.

In nature there are three principal forms of locomotion: walking, swimming, and flying; and three great highways, earth, water, and air. The earth, when struck by the travelling surfaces of animals, feet, fins, and wings, affords an *unyielding* fulcrum and a maximum of support and recoil; the air, when similarly treated, affords a *yielding* fulcrum and a minimum of support and recoil, the water being intermediate in these respects. There is a visible connection between the several forms of locomotion on the one hand, and the highways acted upon on the other. Nature modifies the travelling surfaces of animals, and adapts their movements to the earth, the water, and the air respectively. If a land animal strikes the ground with its travelling surfaces sufficiently hard, it does one of two things: it either displaces the earth or displaces itself; if it displaces itself, which it invariably does, it walks, runs, or leaps. If a fish lashes the water with its tail with sufficient energy it not only displaces the water but it displaces itself, and this is swimming. If a flying creature strikes the air with its wings with sufficient power it displaces the air and itself at one and the same time, and this is flying. Locomotion, therefore, in animals, as witnessed in walking, swimming, and flying, is purely a physical problem. There is nothing mysterious in it.

The air, like the water, is a fluid, but it is immeasurably less resisting and immensely lighter than the water, the weight of the latter when compared to the former being something like 1000 to 1. If the air, which furnishes the highway for the wings of flying creatures, were as gross and palpable as the water and the earth, there would be no difficulty in revealing the secrets of flight. It is the tenuity and levity of the air which misleads the judgment and baffles the comprehension. Bodies which float in water sink or fall in air. The air, like water, supplies a yielding fulcrum to the travelling surfaces of animals acting upon it, but the recoil obtained from air is feeble indeed as compared with that obtained from water. Air, therefore, is the most difficult form of matter to deal with, so far as locomotion is concerned. Nature, however, is equal to the occasion, as millions of flying creatures testify. In flight one of two things is absolutely necessary: either the wings must be driven at great speed in still air; or the air, violently agitated, must strike the under surfaces of the wings moving gently, or held in one position at an upward angle. This is a *sine quâ non*. The principle here involved is best explained by an illustration given by Mr. Pettigrew. If a boy's kite is to be flown in *still* air, one boy holds up the kite obliquely, and another boy, with the string in his hand, runs forward at a given signal. By this means the oblique under-surface of the kite is made to strike or attack the still air. If the kite is to be flown when there is a *stiff breeze blowing*, the boy with the string in his hand does not require to run forward when the other boy lets go the kite. The breeze does the running for him. In this case the air currents strike or attack the under oblique surface of the kite and force it upwards. It is in this way, explains Mr. Pettigrew, that the albatross is flown by the trade winds of the Southern Ocean. In a stiff breeze, all this magnificent bird has to do in order to fly (initial velocity having been obtained) is to expose the under surfaces of its long narrow wings, each measuring from six to seven feet, at a certain upward angle to the horizon, kite fashion. The quickly-moving air does the rest. In such a breeze the albatross may not unfrequently be seen wheeling about in space for a whole hour at a time without once deigning to flap its enormous pinions.

While water and air have many things in common, they are not identical as far as locomotion is concerned. When a bird propels itself in water the feet strike backwards. If, on the other hand, a bird wishes to propel itself in air, the wings are made to strike forward. The swimming bird's feet push the body forward; the wings of the flying bird pull the body forward.

Weight, however paradoxical it may appear, is necessary to flight. Everything which flies is considerably heavier than the air. The inertia of the mass of the flying creature enables it to control and direct its movements in the air. It follows that the balloon has no analogue in nature. In a calm the balloon can only rise and fall in a vertical line, and if air-currents are present it is wafted about, and is, in fact, completely at the mercy of the wind. It is, therefore, useless as a means of transport from one point to another. The balloon is a mere lifting apparatus. The mode of suspension in the air of the balloon is wholly different from that of the bird. The balloon floats because it is lighter than the air, whereas the bird floats because it extracts from the air, by the vigorous downward action of its wings, a certain amount of upward recoil. The balloon is passive; the flying creature is active. The balloon is controlled by the wind; the flying creature controls the wind. The balloon, in the absence of wind, can only rise and fall vertically; the flying creature can fly in a horizontal plane in any given

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direction. The balloon is inefficient because of its levity; the flying creature is efficient because of its weight.

Mr. Pettigrew explains very clearly that while there is no law as to the size of wing required for elevating a certain weight, there is a law which regulates the size of the wing and the number of beats made by the wing in a given time, provided the weight to be raised is the same. There is also a general law to the effect that the greater the weight to be elevated the smaller by comparison is the wing surface. Mr. Pettigrew remarks that it is quite evident, judging from what we find in nature, that flight is to a large extent a question of weight and power of body, and size and speed of wing. It has been estimated that the common fly moves its wings 330 times per second, and that the butterfly moves its wings only nine times per second. It has been proved that the wing is driven more slowly in proportion to its length. Large gulls, for instance, flap their wings much more slowly than small ones, the configuration and relative size of the wings to the body being the same in both. Mr. Pettigrew reasonably considers that the existence of these laws promises well for the future of flying machines, as flying surfaces of even heavy flying machines need not necessarily be very large. A flying machine may obviously be constructed on one or two principles: it may be a heavy, powerful machine, with small wings driven at high speed; or a light, weak machine, with ample wings, driven at a slower speed.

Aerial navigation has been repeatedly grappled with by men of high scientific attainments in this and other countries, but the complex problem appears at present to be as difficult of solution as the finding of the proverbial philosopher's stone. Mr. Pettigrew has wisely remarked, "there is no more difficult or important problem before the world at present." Still, that which may now appear a problem insolvable by human ingenuity may eventually, by dint of patient and painstaking investigation, be completely and satisfactorily accomplished.

RICHARD HOLLAND.

The Microscope

As Applied to the Study of Fungi.

BY THE REV. J. E. VISE, M.A., F.R.M.S.

THE students of fungi may naturally be divided into groups—those who study the larger kinds only, and those who study the microscopical forms, with or without the larger kinds, also. As to the first of these, there is not the need of so thorough an examination of plants all the year through, as most of the larger kinds have no solid flesh capable of enduring severe frosts. The autumnal part of the year is the most favourable for them. A microscope is by no means an independent part of the work; therefore the manipulation of the instrument—which, like everything else, cannot be gained without suitable preliminary training—is not necessarily a part of the education. But as to the second group: the use of the microscope gives extra relish for investigating the small forms of vegetable life. Moreover, the small forms may be investigated all the year round; each separate month may give different developments of one and the same fungus. By this means the life history may be watched and studied, and become very absorbing as well as very instructive. The task may be difficult, but, when completed, the reward for the toil and labour bestowed is well repaid. Besides, the field of investigation for the microscopical student is very much more extensive as to the number of the plants than for those who can only take the large forms. The increase in the discovery of new microscopical fungi is immensely greater than for the other kinds, hence new species may be found more frequently. Then, as to preservation of species for reference: the small forms are more easily preserved for the cabinet and future reference than the others, whether in the herbarium or as slides notwithstanding the fact that there are difficulties in both. The herbarium in a place liable to atmospheric changes is sure, sooner or later, to be attacked with some vegetable growth to damage the specimens—a source of special annoyance with unique plants—or the ravages of insects may reduce specimens to a powdery dust, and render what formerly was prized equal in value to nothing. Then, again, there really is a good deal of trouble with microscopical slides. Their numbers accumulate. This is to be met by carefully arranging them so that when you want a specimen out of your cabinet of one hundred, or some tens of thousands, you may at once be able to put your hand upon the exact specimen you want. I have given up every plan for the following, which is, to have trays of one uniform size containing room for thirty-six slides each, and to have always on hand a stock of empty trays to insert here and there, as necessary, just as you would put books in your library shelves. By keeping to families, genera, and a few details, such as not overcrowding, the difficulties of arrangement become easy.

Now, as to the medium in which these microscopical slides are to be mounted. Who knows which is the best out of the numbers there are? I have worked at the microscope for 35 years and cannot tell yet, nor do I think the man is born who can tell. What suits one fungus does not necessarily suit another. Canada balsam contracts the spores, and is apt to distort them. Glycerine, pure and simple, simply refuses in course of time to remain in the cell of the slide, and works its way out. Glycerine jelly is nearly as bad, and, in common with gelatine medium, contracts and expands with the temperature of the weather, and, therefore, is unreliable. Thwaite's fluid, like water, may be very successful for a time, but will be sure to change the colours of the tissues eventually. Camphor water, and the other media which have been used in the vain attempt of beautifully balancing themselves, so as to check either the decay or growth of the plant, all fail. Not one is perfect. We may do our best, but success, is not assured. If anyone asks me what media I now use and recommend others to use, my answer would be—for any fungi that would bear them (and they are not numerous) employ Canada balsam. First take the greatest possible care to keep the spores in their natural place by giving them as small a quantity, not of pure spirits of wine, which scatters them, but benzole, which has a different effect. Let the benzole evaporate, then mount. When Canada balsam will not suit, as is generally the case, I use gelatine, warming all the materials used. Water, I may say, is, to the best of my knowledge, indispensable, when you want to see such portions of a fungus as the zoospores. Much advantage may be gained by putting on the label of the slide not only the name of the object, but the medium in which the same is mounted. I have slides in my cabinet of great scarcity, which it would be next to impossible to replace; some of them have lost the whole of the medium in which they were placed through evaporation, and are almost valueless. Others have not gone so badly, but there are large bubbles of air in them, which are the forerunners of total evaporation. Had the original mounter of the same named the fluid in which they were placed on the slide there would have been little difficulty in bringing them back to their primitive condition.

I would add a word of caution to beginners. Be very careful not to use high-power object-glasses with high eyepieces; if you want high powers, always use low eyepieces. The strain on the eye is not anything like so great when this plan is adopted. Besides, with high-power object-glasses you may get any amount of magnifying power that is necessary. Again: use as little light as you well can from the mirror. It is a very wrong notion indeed that a great light is essential. Always get a subdued light—one that is not in the least liable to strain the eye at all. The definition of the slide will be just as good—indeed better, the time occupied will be much better employed, because you will work longer, and the comfort to yourself at work will be considerably improved. Then, again, banish to the

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winds the idea that you cannot keep both eyes open when working with a single-tubed microscope-monocular, as it is called. There are several ways by which this may be effected :—One is by having a black sheet of paper near to the second eye ; another plan is to put your hand before your eye. Perseverance is all that is needed. One evening is quite enough to make anyone skilful, if he is determined to succeed. He need no more fear seeing things on the table with the second eye than seeing the crown of his head, unless he is in training for drawing objects on the table by means of a camera from the instrument, whilst with one eye he looks at the object, and with the other draws the figure. A very little reflection will convince any one how desirable it is to keep the nerves of the eye as nearly in their right position as possible. An undue strain is caused if they are strained, and the sight is injured if much work is done. Let us all, young and old microscopists, be very sceptical at times as to what we think we see with the very highest powers. Without wishing to detract an iota from the honesty of purpose and truth of my fellow-students, I am sure that a good deal unintentionally has been said to have been seen with the microscope which has never been seen at all. We set to work longing to discover something newer than the last new thing. We hope to find it, we begin to think we have found it, and we may go so far as to make ourselves believe we really did see it once. The event must be recorded ; we proclaim it, and in so doing propagate error. The microscope, like the photographic apparatus, has its defects. Let us enjoy seeing what glories there are in it, and without hesitation use it for the best and purest purposes.

Forden Vicarage, Welshpool.

On the Colour of the Skin.

PROFESSOR ROBERT WALLACE, has lately contributed to the Royal Society of Edinburgh an interesting paper on the colour of the skin of men and animals in India. According to his observations, Indian cattle have generally jet black skins. The hair is frequently white, grey, brown, or black ; but only in rare cases are the skins white. In these exceptional cases the animals are weakly, and are liable to blister with the sun or to become leprous.

This circumstance that the skin of cattle in India is generally black opens up and widens the scope of a most interesting question on the relation of colour to climate. According to Professor Huxley—a recognised authority of distinction upon the subject—this relationship is by no means at present understood. The field of investigation as regards India is a large one : it embraces the human races, and the breeds of cattle, sheep, pigs, buffaloes, and horses. The skins of all these are black or dark coloured. The few white exceptions noticed by Mr. Wallace were in buffaloes and cattle which were unhealthy. The white or grey hair so prevalent in cattle extends to the Arab horse, and would appear to be, when associated with the black skin, especially adapted to resist the intense heat of a tropical sun. When it is known to be a scientific fact that white does not absorb heat so quickly as black, it seems paradoxical that the skin should be black instead of white in India and the tropics. And it is even more wonderful that the skins of the lower animals should follow the same great natural law, so antagonistic to scientific conclusions.

However, though it would seem at first sight that the black skin should be a disadvantage on account of its quick absorption of heat, it is not really so. The black colour of the skin causes it to absorb more heat than a white skin, but while it is doing so, at the same time and for the same reason, it is giving off more heat ; that is, its radiating power corresponds with its absorbing power. Therefore, in the Professor's opinion, when the sun's rays impinge upon the skin, the heat is rapidly absorbed ; but, as the rate of absorption of heat is greater than the rate of radiation, unless the temperature of the skin were lowered by some other influence, the whole surface of the body would become extremely hot.

To complete the explanation he takes into consideration what is known of black-skinned men. When he was in India he observed that natives, although they drank water freely, do not appear to perspire so copiously as Europeans, but this apparent absence of perspiration is owing to the freer exudation of invisible moisture in the form of vapour. Sweat-drops are not seen on the skin, but an enormous quantity is constantly evaporating in invisible perspiration. Now, in the evaporation of the moisture exuding from the skin, there is a demand for heat far greater than an ordinary observer would imagine ; and by it can be disposed of all the surplus heat which the black skin absorbs over and above what it gives off by radiation. This fact, so ably dwelt upon by Mr. Wallace, is realised by few, that the amount of water is small indeed which, by being evaporated, could transform into its latent condition all the heat derived from the warming influences of the sun in the hottest climates.

Notes in the Parks.

THERE is no more striking object in the parks at this season of the year than the bright red bark of the dogwood (*Cornus sanguinea*). Well does it deserve its specific name, for its branches almost appear as if they had been dipped in blood. This character gives it in some places the name of bloody twig, and it appears to be the plant alluded to by Pliny under the name of *Virga sanguinea*. According to Prior, its popular name of dogwood (it is also known as dogberry, hounds-tree, and prickwood) has no reference to the animal, but is connected with the use of its wood for making skewers—from old English dagge, equivalent to German *dolch*, a dagger.

The Rev. C. A. Johns, on the other hand, says it is called dog-wood because "the fruit is not fit even for a dog ;" whilst, according to Lindley, it is so called in consequence of a decoction of its bark having formerly been used for washing mangy dogs. The horny hardness of its wood is alluded to in its generic name—cornus, from cornu, a horn—and causes it to be much sought after as a material for skewers. In the late spring, or early summer, it bears at the ends of its branches clusters of small white flowers, each with four spreading petals. These are succeeded in August or September by small globular black berries, very bitter, and capable of yielding an oil suitable for soap-making or for burning in lamps.

An observant visitor can scarcely fail to notice also the alder, with its somewhat stiff-looking branches ; pendulous, cylindrical male catkins, which have been hanging on the tree since the autumn, and the oval, black remains of last year's fruit, resembling miniature fir cones. Owing to the filbrous character of its roots it attracts and retains the moisture around it, so that a plantation of alders may render the ground soft and spongy, and in time convert it into a decided bog. Its wood is very durable if kept entirely submerged or buried in damp earth ; hence the young branches are used for filling in drains. It also furnishes a charcoal much valued by gunpowder manufacturers.

The hazel, like the alder, bears its barren and fertile catkins on the same plant. The latter, small and inconspicuous—but with the crimson pistils of the flowers pushing forth from among the dull encircling scales, not less beautiful than the larger, golden yellow barren catkins—are scarcely known to any but botanists. In the course of a few months they will be replaced by bunches of nuts, in each of which a beautiful little beetle—the nut weevil (*Balaninus nucum*)—will probably deposit an egg, boring a hole for the purpose into the young and still soft fruit. Having in this way disposed of her whole stock of eggs, and her business in life finished, she will die. The eggs in time will be hatched and the young larvæ will feed on the substance of the nut, carefully avoiding a vital part, so that to all external appearances the nut will be

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perfectly sound and good. As soon as the larva is full-fed—which will be about the time that the fruit is ripe—it will nibble a round hole in the shell of the nut, escape through it and fall to the ground, into which it will wriggle its way, and then undergo its transformations, leaving the nut filled with a bitter black powder instead of the richly-flavoured kernel.

Dormice nibble away the husk, gnaw through the shell, and then extract the kernel piecemeal. The nuthatch gathers the nut by the stem, carries it to a rough-barked tree, such as the oak, and having fixed it in an angular crack in the bark proceeds to crack it by repeated blows with its beak. The depredations committed by squirrels, however, where these animals abound, far exceed those of all the others.

Students will find in the opening buds of the lilac an excellent proof of the homology of bud scales with leaves. Not only are they arranged in the same manner, but every gradation will be found from the short broad scale at the base of the bud to the well known ovate leaf. They are clearly homologous with the leaf-blade; but a careful examination of the buds of the flowering currant will show that in that plant they may be regarded as modified stipules combined with leaf-stalk. In the horse chestnut they represent the leaf-stalk, while in the the beech they are evidently stipules.

As the buds open the scales fall off. The scars they leave form a very distinct ring on the stem, and furnish us with a measure of its elongation from year to year, the distance from ring to ring evidently representing a year's growth. H. L. Edwards, F.I.C.

The "Recent Additions" Case at the British Museum.

SINCE the removal of the Natural History Section of the British Museum to South Kensington, the adoption of the idea of a "Recent Additions" case has enabled visitors to appreciate the valuable finds of minerals which occur from time to time. Previous to this plan being adopted, any new acquisition was lost in the multitudes of treasures by which it was surrounded, except when of such size as to claim a special case for itself, as did the remarkable group of stibnite crystals from Japan, and the charming lot of pink tourmaline crystals on granite from Elba.

During the past two years the recent additions have been principally made from the magnificent finds of copper and lead minerals in the Rocky Mountains, but the present occupants of the case have a decidedly European, indeed British, aspect. Perhaps the most prominent feature in the case is the collection of calcites from Cumberland (of which about thirty specimens are shown), as these newly-found crystals are fully equal to any previously met with from any locality in transparency or lustre. Some crystals of four to five inches long are as clear and limpid as glass, and when, as in some cases, tinted by a slight amount of oxide of iron, they are of charming delicacy. Perhaps, however, it is their crystalline development which gives them their great value to mineralogists. Collectors of minerals well know the great scarcity of the peculiar twin crystals from Eyam, in Derbyshire (the butterfly twin), which are only to be met with in old collections. This Cumberland find has produced a series of twins of the Eyam habit which far exceed those from the parent locality in size and beauty, associated with others on the Eyam type, but presenting a remarkable development of the rhombohedral faces, and still another set of twin crystals that seem to be on a type peculiar to the locality. Yet another type of twin is found which resembles those crystals from Wheal Wrey, in Cornwall, where hexagonal prisms are fixed at right angles to each other. In addition to these twin crystals there is a large series of simple forms exhibited, many of which present striking peculiarities, and as they are being worked out by that indefatigable crystallographer, H. A. Miers, we shall soon know more about them. The manner in which these large twins (which may be roughly likened to triangular plates), weighing over a pound, were attached to the parent rock on a point less than a quarter wide, seems marvellous. The Gloucester Celestites form the next important group. Here we have crystals with ordinary Catanian habit associated with those of the Erie type, and these again with forms that resemble the Dufton cystals of baryte. From this same locality we have, in addition to these various type forms, three specimens which are probably unique, the crystals being long unmodified four-sided pyramids, some of which show double terminations. Lake Erie formerly produced the largest crystals of Celestite, but now our English county takes first place. The fine group of barytes crystals from Shropshire has just been placed in the main collection, but in its place we find a group of Witherites completely eclipsing anything before seen. These are obtained from the old classic locality, Hexham; crystals doubly terminated up to six inches long are shown.

Among other new things exhibited are fluor spar from Switzerland, in cubes, displaying etching planes, and measuring over five inches from angle to angle; Scheelite crystals, two inches from end to end; Diopside, from Ala Piedmont; Phenakite, from Colorado; Apatites, of purple and pink colour; Adamine, from the old zinc mines of Laurium, in Greece; a fine blende from Cornwall; native copper, from the Serpentine mine at Mullion, in Cornwall; also, specimens of Bertramite, Eudidymite, and Inesite.

Mr. Pritchard Morgan's Welsh gold mine is represented by a fine piece of gold-impregnated quartz, presented by that energetic discoverer; and a small specimen of gold in calcite, from Australia, will probably tend to dispel some wild notions as to the origin of the noble metal.

Taken as a whole, the present occupants of the case, though they do not give such a brilliant show of colour as their immediate predecessors, are perhaps of more scientific interest, and certainly prove that in the mineral kingdom we have not yet ransacked the whole of nature's storehouse of gems. W. Semmons.

Pseudo-Scolites.

THE interest at present shown on the supposed fossil worm-burrows in the older rocks of the Southern Highlands induces me to draw attention to the formation of certain tube-like markings, or foralites, which occur on sloping, sandy shores, more especially when the sand covers a deposit of shingle.

I have seen these holes occurring for miles along the shore here and in other places. Their formation is interesting, for they appear to be simply vents formed in the wet sand by the escaping air which has been compressed by the advancing waves.

In a given slope of shingle, covered with a layer of wet sand, we have a certain quantity of air; this, on being compressed by an advancing wave, cannot escape through the wet sand until a certain pressure is exerted. The advancement of the wave increases the pressure, and the confined air commences to escape from the weakest points at the surface of the sand; from the vents thus produced air issues with considerable energy, as the bubbles forced through the *retreating* water show.

The receding tide leaves these miniature blow-holes intact, and, frequently, with a crater-like ridge of sand around their orifices, and there is no doubt but that under certain favourable conditions their forms might be preserved from future obliteration. These holes have frequently been pointed out to me as worm burrows, but investigation as to their mode of production showed them to be *pseudo-scolites*.

Cecil Carus-Wilson.

Bournemouth, March 8th, 1889.

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List of the Plants of the Isle of Man.

By the Rev. Samuel Gasking, B.A., F.G.S.,

Corresponding Member of the Isle of Man Natural History and Antiquarian Society, Member of Council of Liverpool Naturalists' Field Club, &c.

Order 1.—*Ranunculacee.*

Anemone nemorosa—Wood anemone.
Ranunculus aquatilis—Water crowfoot.
Do. Lenormandi—Mud do.
Do. hederaceus—Ivy-leaved do.
Do. ficaria—Pilewort.
Do. flammula—Lesser spearwort.
Do. lingua—Great spearwort.
Do. acris—Upright buttercup.
Do. repens—Creeping crowfoot.
Do. bulbosus—Bulbous do.
Caltha palustris—Marsh marygold.
Aquilegia vulgaris—Columbine.
Aconitum napellus—Monkshood.

Order 3.—*Nymphaeacee.*

Nymphæa alba—White water-lily
Nuphar lutea—Yellow do.

Order 4.—*Papaveracee.*

Papaver hybridum—Round prickly-headed poppy.
Do. argemone—Long do.
Do. dubium—Long smooth-headed poppy.
Do. rhœas—Common red poppy.
Do. somniferum—White do.
Glaucium luteum—Yellow-horned poppy.

Order 5.—*Fumariacee.*

Fumaria capreolata—Rampant fumitory.
Variety 3.—*Borei.*
Do. officinalis—Common do.
Corydalis claviculata—White climbing corydalis.

Order 6.—*Cruciferæ.*

Cakile maritima—Purple sea-rocket.
Crambe maritima—Sea kale.
Thlaspi arvense—Field penny-cress.
Capsella bursa-pastoris—Shepherd's purse.
Lepidium Smithii—Smooth field pepperwort.
Do. campestre—Common do.
Cochlearia officinalis—Common scurvy grass.
Variety 2.—*Alpina.*
Variety 3.—*Danica.*
Do. Anglica—English do.
Do. armoracia—Horse-radish.
Cardamine pratensis—Cuckoo flower.
Do. hirsuta—Hairy bitter-cress.
Nasturtium officinale—Water-cress.
Do. palustre—Marsh yellow-cress.
Sisymbrium officinale—Hedge mustard.
Do. alliaria—Garlic do
Erysimum cheiranthoides—Worm-seed treacle do.
Cheiranthus cheiri—Wallflower.
Brassica monensis—Isle of Man cabbage.
Sinapis arvensis—Charlock.

Order 7.—*Resedacee.*

Reseda lutcola Dyer's weed.
Do. suffruticulosa—Shrubby mignonette.
Variety 2.—*Alba.*

Order 8.—*Cistacee.*

Helianthemum guttatum—Spotted annual rock rose

Order 9.—*Violacee.*

Viola palustris—Marsh violet.
Do. canina—Dog do.
A. sylvatica.
Variety 1.—*Riviniana.*
C. canina.
Variety 2.—*Flavicornis.*
D. lactea.
E. stagnina.
Do. tricolor—Pansy.
Variety 2.—*arvensis.*
Do. Curtisii—Curtis' pansy.
Do. lutea—Yellow do.

Order 10.—*Droseracee.*

Drosera rotundifolia—Round-leaved sundew.

Order 11.—*Polygalacee.*

Polygala vulgaris—Milkwort.
Variety 3.—*Oxyptera.*

Order 14.—*Caryophyllacee.*

Saponaria officinalis—Soapwort.
Silene inflata—Bladder campion.
Do. maritima—Sea do.
Do. anglica—English catchfly.
Silene acaulis—Moss campion.
Lychnis flos-cuculi—Ragged robin.
Do. diurna—Red campion.
Do. vespertina—White do.
Sagina apetala—Annual small-flowered pearlwort.
Do. maritima—Sea pearlwort.
Do. procumbens—Procumbent do.
Spergula arvensis—Corn spurrey.
Honckenya peploides—Sea purslane.
Spergularia marina—Seaside sandwort-spurrey.
A. neglecta.
Do. rubra—Field do.
Arenaria serpyllifolia—Thyme-leaved sandwort.
Do. verna—Vernal sandwort.
Do. triverris—Three nerved do.
Stellaria media—Chickweed.
Variety 2.—*Borœana.*
Do. holostea—Greater stitchwort.
Do. graminea—Lesser do.
Do. uliginosa—Bog do.
Cerastium glomeratum—Broad-leaved mouse-ear chickweed.
Do. triviale—Narrow-leaved do.
Do. tetrandrum—Four-cleft do.
Do. arvense—Field do.

Order 15.—*Linacee.*

Linum usitatissimum—Common flax.
Do. angustifolium—Narrow-leaved do.
Do. catharticum—Purging flax.
Radiola millegrana—Thyme-leaved flax seed.

Order 16.—*Malvacee.*

Malva moschata—Musk mallow.
Do. sylvestris—Common do.
Do. rotundifolia—Dwarf do.
Althæa officinalis—Common marsh do.
Lavatera arborea—Sea tree do.

Order 18.—*Hypericacee.*

Hypericum androsæmum—Tutsan.
Do. perforatum—Common St. John's wort.
Do. quadrangulum—Square-stalked do.
A. dubium.
Do humifusum—Trailing do.
Do. pulchrum—Small do.
Do. elodes—Marsh do.

Order 19.—*Aceracee.*

Acer pseudo-platanus—Sycamore.

Order 20.—*Geraniacee.*

Geranium pusillum—Small-flowered crane's bill.
Do. molle—Dove's-foot do.
Do. dissectum—Jagged-leaved do.
Do. Robertianum—Hert Robert.
Erodium maritimum—Sea stork's bill.
Do. cicutarium—Hemlock do.

Order 22.—*Oxalidacee.*

Oxalis acetosella—Wood sorrel.

Order 25.—*Leguminosæ.*

Sarothamnus scoparius—Broom.
Ulex Europæus—Common gorse.
Do. nanus—Dwarf furze.
Genista tinctoria—Dyer's green weed.
Ononis arvensis—Common rest harrow.
Anthyllis vulneraria—Kidney vetch.
Melilotus alba—White melilot.
Trifolium repens—Dutch clover.
Do. hybridum—Alsike do.
Do. fragiferum—Strawberry trefoil.
Do. arvense—Hare's foot do.
Do. pratense—Purple clover.
Do. medium—Zig-zag trefoil.
Do. procumbens—Hop do.
Do. minus—Lesser yellow do.
Lotus corniculatus—Common bird's foot trefoil.
Do. major—Narrow-leaved trefoil.
Astragalus hypoglottis—Purple mountain milk vetch.
Ornithopus perpusillus—Bird's foot.
Vicia sylvatica—Wood vetch.
Do. cracca—Tufted do.
Do. lathyroides—Spring do.
Do. sativa—Common do.
Variety 3.—*angustifolia.*
Lathyrus pratensis—Meadow vetch.

(TO BE CONTINUED).

Professor Lapworth on the Red Rocks of Cheshire.

In the course of a recent lecture, delivered at Liscard, Professor Charles Lapworth, F.R.S., F.G.S. (of the Mason College, Birmingham), described the general characteristics of the scenery and physical geography of Cheshire, which county, he said, was a part of the great midland plain of England, floored by rocks of the New Red Sandstone age. Comparing the scenery of England and America, he referred to the monotony of a long railway journey in that country, contrasting it with the variety of scenery experienced during a single day's journey in our own land. This is due to the fact that, geologically speaking, ours is an older country. North America consists of two long mountain ranges, with a great plain between. The Red Rocks of England were then described as lying between two deep-sea formations, the beds being only part of a great European formation, covering a distriet 2,000 miles in circumference, and varying in thickness from 1,000 to 4,000 feet. The characteristics of these beds remain constant throughout the whole area. Whilst the beds below and above teem with organic remains, the Red Rocks are almost barren of them. The lower strata are usually composed of sandstones and pebbly beds, whilst the upper consist chiefly of marls, in which salt is formed. Over the districts covered with marls there is everywhere a rich agricultural country; where the pebbly beds occur, on the other hand, the scenery is more or less of a romantic character, with barren soil and pine-covered hills, whether seen in Delamere Forest, or in France, or in Germany. These red beds everywhere present the greatest difficulty to the geologist.

Turning to the Himalayas, Professor Lapworth deseribed the immense mass of pebbles, sand, and clay brought down from the higher lands, and forming lower ranges of hills and the rich plains of Bengal. The northern side of this range is a barren desert, covered with the same pebbles and sand, and the district is gradually drying up. Floods bring down quantities of *debris*, forming lakes in the wet season, which, in the dry season, form long stretches, or salt-covered plains. The sand is coloured red with peroxide of iron. The desiccation of Central Asia is regarded as being due to the elevation of the Himalayas, this range of mountains having cut off the supply of moisture from the Indian Ocean. A great similarity appears between this desert region and our own Triassic beds, where much of the rock shows both æolian and torrential action, whilst the drying up of the inland seas leaves a red marl. Professor Lapworth suggested that during Triassic times a prolongation of the Scandinavian range across the north-west of Scotland and the west of Ireland, along the ancient Palæozoic ridge, would shut out all access of rain clouds from the south and west, and would produce conditions similar to those now prevailing in Central Asia. Turning again to America, he pointed out that the same process was beginning to be in operation there; that the desert region east of the Rocky Mountains was gradually spreading eastward, and would eventually cover the whole of the plains between these mountains and the Alleghanies. These conditions would continue until the mountains had been sufficiently lowered in height by denudation, so as to admit of a more copious rainfall—a similar process to that which had operated in Europe during the Triassic age of our geological history.

Scientific Men and Insurance.

By A. Arthur Reade.

"I wish you with all my heart success in your philanthropic work," wrote Dr. Dallinger, in a recent letter written to the writer in reply to an inquiry for the doctor's opinion on life assurance. "Not only," continued the genial professor, "does it give a young man through all his life the assurance that, amidst all the vicissitudes of

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commercial circumstance, there remains that which will permanently benefit those whom he would cherish when his work is done, but he becomes a benefactor to the nation; his thrift is a permanent and positive good."

Professor Boyd Dawkins still more emphatically commends it to science workers. "In my opinion," he remarks, "all professional and other men without capital should insure their lives in all cases where they have people depending upon their incomes. To a large class, life assurance is the only mode of saving from annual income, and of preventing wives and families from being left destitute."

The circumstances in which the late Mr. R. A. Proctor left his family, and the recent correspondence in *Science and Art*, indicate that science teachers have not given the subject of life assurance the attention its importance demands. Some are so absorbed in contemplating those other worlds, the stars, that they seem to have forgotten the stern realities of existence in this. One correspondent of our contemporary frankly confesses that he has no better reason than laziness for not insuring his life, but hopes soon to redeem his character. Another correspondent suggests that, as there are 14,000 or 15,000 science teachers in the United Kingdom, special terms should be obtained from some good Company. The suggestion, as the editor points out, is scarcely likely to be adopted by any first-class office, because the rates are based upon the law of averages, and it is impossible to make any reduction, however large the number of entrants might be.

The subject of life assurance has been approached chiefly from the religious side, but the investment element now forms one of its chief attractions to commercial men: they regard it as the best investment possible, and take out policies for very large amounts, in some cases for £20,000. At the present time, the most popular form of life assurance is an endowment payable at a given age. The premium is a little more than that for a whole-life policy, but a two-fold purpose is accomplished by an endowment policy, which secures:

1. A sum of money at a given age.
2. A provision for a family in case of the death of the assured before the endowment matures.

By this plan a man may reap the benefit of his own prudence; if he should die, his family will reap the benefit. An endowment policy, therefore, combines both insurance and investment. This not only affords the best security; it actually dispels care, and so, by lessening the friction, increases the length of life. A policy-holder incurs no liability; his mind is free from anxiety as to the future of his family if he should be cut off; he has no income-tax to pay on his premium; and he can face old age with a reasonable hope of being independent of charity.

Notes in Brief.

Dr. James Bell, F.R.S., has been re-elected President of the Institute of Chemistry for the ensuing year. In his presidential address Dr. Bell indicated several directions in which the efficiency of the Institute can be much improved; and among other improvements suggested was an annual meeting of the Fellows, to last two or three days, at which papers might be read and discussions held on subjects in practical chemistry.

A sensational incident in one of Victor Hugo's novels is a fight between a man and an octopus, or "devil-fish." According to an account received from New Zealand, an encounter in real life has taken place in Wellington Harbour, where a diver, who was in the act of setting some large blocks under water, was seized by an immense octopus. The monster fastened itself at the same time to a wooden pile, and the more the diver struggled the stronger became the grip of the animal. At length it released its grasp, and the diver was drawn to the surface with the octopus on his back. The limbs of this cephalopod measured nine feet in length.

A New Orleans planter has lately placed in the market samples of first-class papers made from sugar-cane refuse. The planters feel keenly the serious decrease in the price of sugar, and any suggestion which is likely to ameliorate their condition is deserving of attention. By this new process about 24,000 lbs. of paper can be manufactured for something under £85. "Sugar-cane paper" is made from the crushed cane from which the syrup has been extracted.

The application of gaseous fuel to metallurgical operations results in many advantages, including a great saving of cost. A bold scheme has been promulgated by Mr. B. H. Thwaite, C.E., by which he conceives it possible to supply the towns of England with gas brought in pipes from the coal-fields of South Wales, Staffordshire, and South Yorkshire. The gas would be conveyed through mains at great pressure, and distributed to towns much in the same way as the natural petroleum is conveyed to various stations in Pennsylvania.

According to the London edition of the *New York Herald*, Mr. R. S. Newall, of Ferndene, Gateshead, has offered to present to the University of Cambridge his refracting telescope, which has a 25-in. aperture and a 30-ft. focal length, together with the dome and instruments connected with it.

Professor Fouque has communicated to the French Academy of Sciences the result of his examination of the famous blue pigment cœruleum, used by the ancient Romans for wall decoration. He showed it was a compound of silica, copper, and lime. Working with great care he produced a chemical combination neither glass nor enamel, in the form of perfectly definite crystals of a deep sky blue when viewed from the surface, and pale rose edgeways. The difficulty of producing it lies in attaining the right degree of heat, which must not exceed a bright red.

It is gratifying to record that the Selborne Society, in its various branches, is engaged in useful work. The Society has protested against the wholesale felling of the picturesque and venerable oaks situated in Richmond Park, and have memorialised the Office of Works to provide additional seats in the Park.

More "vandalism" in the Lake District. A correspondent to a contemporary complains that the lovely walk along Loughrigg Terrace, at the south end of Grasmere Lake—a walk which was a special favourite with Wordsworth—is disfigured by the opening of a quarry on the centre of the hillside, with its hideous spoil-bank of broken slates and other *debris*.

In this case it may be considered a disfigurement to have the familiar outlines of a beautiful scene altered in any way. A quarry is not, however, necessarily an eyesore; many such excavations exist which afford a pleasing break and contrast of colour, adding to the picturesque appearance of a landscape.

From recent reports it would appear that the American alligator is in danger of extinction. Civilisation has proved pitiless in its dealings with wild animals. The hide, teeth, and oil from the alligator are all merchantable, and in many parts of the Southern States the creature is regularly hunted for the sake of these commodities. It will be some time, however, before the "'gator," as he is familiarly termed, will become a rarity in the Gulf States, in Mexico, and in the marshy jungles north of Colon in Central America.

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ACCORDING to Foreign Office reports the supply of natural sulphur from the brimstone beds of Sicily will only last for another six or eight years. The Sicilian deposits have for a long time supplied a great portion of the trade, but its comparative dearness has led to its artificial production from iron and copper pyrites, Le Blanc alkali waste, &c., and, as it is important that the supply of sulphur should be kept up, this artificial production requires further attention.

PETITIONS signed by 42,000 operatives have been forwarded from Blackburn and other towns to the House of Commons, praying the legislature to put a stop to the excessive infusion of steam in Lancashire weaving sheds, which the petitions state is a serious evil, and detrimental to the health of operatives.

THE Carpenters' Company intends to hold an examination, partly oral and partly written, in the theory and practice of carpentry and joinery. Gold, silver, and bronze medals, as well as certificates of merit, will be awarded to those candidates who show sufficient knowledge of such subjects as the nature and properties of timber, joiners' work, and the history of carpentry and joinery.

A PRIZE of £400 is offered by the Town Council of Paris to the inventor of the most reliable system of computing the quantities of electric light used. Five other prizes of £80 are also offered. If any system is only applicable to a continuous or alternate current half of the money offered will be given. The city of Paris will consider itself entitled to the full ownership of all the inventions which may gain prizes.

MR. CHARLES MARVIN, in a pamphlet on petroleum which he is about to publish, entitled "The Coming Oil Age," states that although the first oil well was only sunk thirty years ago, the annual production of mineral oil now amounts to 2,000 million gallons in America and Russia, employs a fleet of nearly 150 tank steamers, circulates through 7,000 miles of pipe lines, and is used instead of coal by nearly 1,000 locomotives and steamers.

MR. IVAN LEVINSTEIN states that the annual production of coal-tar derivatives represents an approximate value of £4,500,020, of which this country contributes about £400,000, or not one-eleventh part, considerably more than two-thirds of the total consumption being supplied by Germany. Next comes Switzerland, and then follows England. The consumption of these colouring matters and other products of coal-tar is constantly increasing. The exports from Germany from 1884 to 1887 show an increase of more than 50 per cent. in three years, whilst the value of our own exports, taking value as a test, was in 1887 a decrease of £52,079, whilst our imports increased by £58,132.

THE Secretary of State in the Department of Posts and Telegraphs in Germany has issued a series of reports upon the extension of the telephone and telegraph, from which it appears that the total length of telephonic lines throughout the world is 966,900 kilometres (each kilometre equals ·621 of a mile), and the wires themselves have a length of 2,724,000 kilometres. There are 33,000 telephone stations in Germany, 4,200 in Austria-Hungary, 4,647 in Belgium, 1,857 in Denmark, and 2,218 in Spain. France has only 28 telephone systems, of which 2 are in Algeria, while Germany has 164. At the commencement of 1888 the number of subscribers in France amounted to 9,847, and in Germany to 33,000. The United Kingdom had 122 systems with 20,426 subscribers, Italy 28 systems with 9,183 subscribers (of whom 1,835 were in Rome, 1,213 at Milan, 992 in Naples, and 748 in Florence). In Luxemburg there were 15 lines with 483 subscribers, in Norway 9 lines with 2,872 subscribers, in Portugal only 2 lines (one of which is at Lisbon and the other at Oporto) with 541 and 349 subscribers respectively. In Russia telephones have also been introduced. There are in that country 36 systems with 7,589 subscribers (of whom 1,500 are in St. Petersburg, 700 at Warsaw, 840 in Moscow, and 700 in Odessa). Sweden has 137 lines and 12 864 subscribers. Switzerland in 1888 had 71 telephone lines with 7,626 subscribers (of whom 1,533 are in Geneva, 1,066 in Zurich, 926 in Bâle, and 544 in Lausanne).

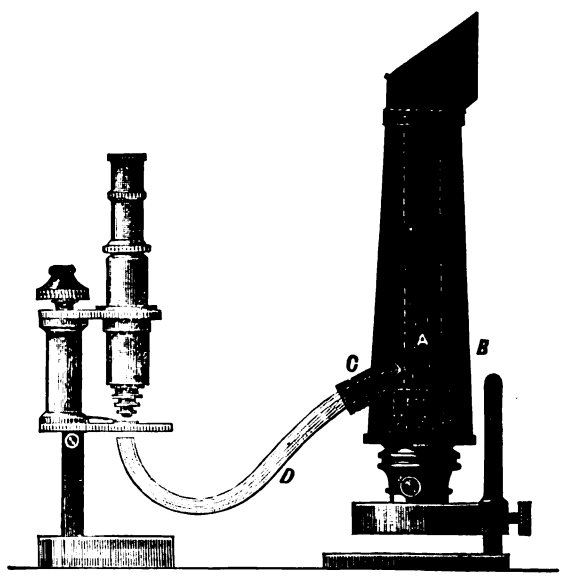
THE annual distribution of certificates to the successful students of the Morley Technical School took place on February 26th. The Mayor (Alderman D. Thackray) presided. An address was given to the students by Mr. J. Clapham, instructor of the school, on the value of technical textile education. Amongst the certificates awarded were the honour certificates from the Clothworkers' Company to Charles Hirst (first class) and Sydney Johnson (second class). Eight other students were presented with certificates awarded by the local chamber of commerce.

THE Jubilee Free Library of Middleton was opened on March 9th by Professor Boyd Dawkins, in the absence of Professor Ward, vice-chancellor of the Victoria University. A gold key, manufactured by Messrs. Elkington & Co., of Manchester, was prepared for presentation to the vice-chancellor on the occasion by the Corporation of Manchester.

BEDS of salt have been discovered in New South Wales, at Ellalong, near Maitland, about sixteen miles from Attandale Station. There is a deposit of crystallised salt 4ft. thick in places, and it is expected that a body of rock salt will be reached below. As about 100,000 tons are used there every year, and the price at present is over £5 per ton, the discovery is of considerable importance.

Koch and Wolz's Microscope Lamp.

A LAMP for microscopical work has been patented in Germany by Dr. W. Koch and Herr Max Wolz, of Bonn. It is shaded by a metal cover, near the bottom of which is placed a solid curved glass rod with a plane end. The light from the lamp passes into the rod, and, after various internal total reflections, arrives at the end of the rod, and from thence it may be directed upon the object.



A is the light, which may be that of gas, mineral oil, or other illuminant; the dotted lines around the light indicate a glass chimney; outside the glass chimney is a metal chimney, on the inside of which

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there is a reflector, **B**; **C** is an opening into which is fitted the glass rod, **D**. The end of this rod is squared off, and is so arranged as to lie underneath the stage. Other rods of different form are supplied for special modes of illumination. The quality of the light can be modified by putting coloured glasses on the end of the rod.

In the specification of the patentees it is stated—"As is well known, rays proceeding from a source of light in a glass body on emergence are deflected from the normal. The more oblique the rays the more are they deflected, the consequence of which is that finally they can no longer emerge, but are reflected back. This happens if the angle of incidence (for glass) amounts to 40¼° and over. Use is made of this physical law in order to totally reflect all light-rays and cause them to pour out on any particular spot. The glass bodies used for this particular purpose are bent into the form of a parabola, and may consist of solid glass or of a glass bell, in which the source of the light is at the vortex of the descending branch of the parabola." This lamp differs much from the lamps usually employed, but is certainly capable of being made of very great use in microscopy.

Museum Notes.

THE Saturday afternoon lectures at the South Kensington Museum have been very successful. By permission of the Lords of the Committee of Council on Education Mr. J. Starkie Gardner has delivered two lectures on "Iron and Artistic Art Work," in the lecture theatre of the museum, and these have been much appreciated. Speaking on "Mediæval Ironwork," he said that one of the earliest iron grills in existence—that on the tomb of Queen Eleanor, in Westminster Abbey—was entirely the work of an Englishman; and a similar screen at St. Denis was either made with English stamps or was the work of a native of this country. In those times England was the pioneer of ironwork. The only perfect grill in existence was that surrounding the choir in Lincoln Cathedral. At the close of the 15th century there came a great influx of art from the east, which influenced metal work in no small degree. The Oriental phase would have been more distinct in England if we had not at that time began to lose our blacksmith's art, partly owing to the fact that wood carving was becoming richer and more elaborate. The 15th century marked the starting point of the *renaissance* of metal work. One of the last specimens of that period, and probably one of the finest examples of ironwork in the world, was a grill formerly round the tomb of Edward IV. at Windsor, now placed under the Royal pew.

ON three Saturday afternoons during March Professor A. Milnes Marshall, D.Sc., gave a series of lectures on the "Mammalian Skeleton," at Owens College, followed by demonstrations in the museum. The course was in continuation of the series given by Professors Williamson and Boyd Dawkins. The aim was to enable visitors to the museum to intelligently appreciate the objects therein displayed, so that they might better understand the things open for inspection. At the first lecture Professor Marshall confined his remarks to a description of the general structure of the mammalian skeleton, the arrangement of the bones, and structure of the teeth. He said that the study of fossils taught us that there once existed on the earth animals which were not identical with species now living, and which had altogether disappeared. It was interesting to know, also, that the whale, which at present is the largest animal living, was in all probability as big, if not bigger, than any animal which existed centuries ago.

THE newly-arranged collections in the museum were recently visited by a large party of members of the Manchester Geographical Society, when Professor W. Boyd Dawkins gave an address on "The Museum: Its Contents and Usefulness," and afterwards explained the principal objects of interest.

PROFESSOR A. H. GREEN recently said of the Malton Museum (Yorkshire) that it was one of the best local museums he had seen, and reflected the utmost credit upon the hard-working curators.

AT the Liverpool Free Public Museum the popular Monday evening lectures still continue to attract visitors. An interesting address was lately given in the Mayer Gallery by Miss E. M. Wood, a lady member of the Naturalists' Field Club, on the antique illuminated manuscripts in the Mayer Collection.

IN the same institution a popular lecture was given by Mr. O. W. Jeffs on "The Story of Rock Salt," illustrated by specimens in the museum cases. Mr. R. Paden described the contents of the newly-opened fish and reptile rooms to an assemblage of visitors invited by the Naturalists' Field Club.

THERE seems to be great need for a revision of the system at present adopted under which the archæological objects are arranged at the British Museum. They are arranged partly in chronological order and partly according to material. Thus, in one room devoted to mediæval archæology, a crosier of the early Irish Church is placed next to an Arabic candlestick. At another place, a cast of an Anglian cross from Gosforth, in Cumberland, is associated with reproductions of Trajan's column and of Scandinavian forts. This is a matter which Mr. Greenwood places before the authorities for their consideration.

ONE of the features of the museum of the Royal Institution, at Bath, is a series of models, to scale, of Stonehenge, cromlechs, and other megalithic structures. Amongst them is the celebrated Lanyon Quoit, near Penzance.

TWO of the collections in the Liverpool Museum are not so well known as they deserve to be. One is the Austin collection of crinoids, collected by the late Major Austin, who devoted many years of his life to the study of these fossils. The other is a very complete collection of shells belonging to the genera *Oliva* and *Nassa*, the work of Mr. F. P. Marrat, in which are included the specimens figured in Mr. Marrat's monograph of the genus *Oliva* in Sowerby's *Thesaurus Conchyliorum*. More than a thousand varieties of the genus *Nassa* have been recorded by this eminent conchologist.

THE overcrowding of specimens at the South Kensington Museum has become so great that it has been determined to remove some of those which are described as "considerable and bulky." A small committee of experts has been appointed to inquire into and report upon the subject. It is no light matter to please professors, and the process of selection will, it is evident, not be without its difficulties.

THE Committee of the Manchester Museum, Owens College, have appointed Mr. W. E. Hoyle, M.A., M.R.C.S., as Keeper to the Institution. Mr. Hoyle was formerly attached to the staff of the *Challenger* office.

A New Form of Reflecting Goniometer.

BY D. CLAGUE, F.G.S.,

Lecturer on Geology, Mineralogy, &c., Liverpool Science and Art Classes, &c.

IN this instrument a carrier, pointed at each end, moves freely round a central pivot on a disc graduated right and left from 0° to 180°. One arm of the carrier bears an upright pillar, on which are, midway, a bar the length of which exactly corresponds with the distance from the centre of the pivot to the foot of the pillar, and on the top a sliding rod, terminated by a pair of nippers, which passes through a ball and socket joint, so securing free movement in every direction.

The crystal to be read is held by the nippers with its solid edge aligned with the two points of sight afforded by the end of the middle bar and the centre of the pivot below, the bearer being placed so that the crystal-bearing end of the carrier points to 0° on the graduated scale. The whole instrument is turned till a pencil of light falls upon and is reflected from one face of the crystal. Then, without moving the instrument as a whole, the bearer is moved round till the pencil of light falls upon the second face of the crystal. The pointer of the

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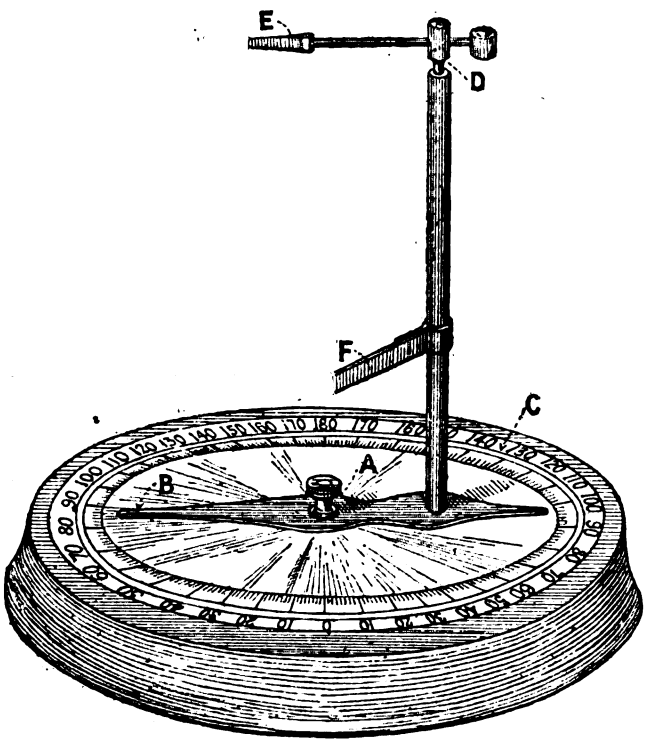
crystal-bearing end of the carrier will then indicate on the graduated scale the number of degrees through which the crystal has been turned, and the opposite end will point to the complementary number, which will be the value of the angle of the crystal.



A. Pivot. B. Carrier, pointed at both ends. C. Disc, graduated right and left to 180°. D. Ball and socket joint. E. Bearer, with nippers at end for holding minerals. F. Sight bar, guiding the line of sight from crystal to pivot.

The principle on which this instrument is designed is identical with that of Miller's simple goniometer, and has been devised to meet some defects in that instrument which were observed in working with it in class-work. The superiority of the new instrument consists in (1) the impossibility of its slipping in moving round the pivot after getting the reflection from the first face, being firmly secured by the pivot-pin, round which it freely moves; (2) the eye of the observer is not diverted from the crystal by the necessity of ruling lines on paper when the first reflection is obtained, so obviating the loss of time and difficulty experienced in getting the eye back to its proper position again; and (3) no calculations are required to find the true angle from its complement, the double-pointed carrier indicating both at its respective ends on the graduated scale.

Our Portrait Gallery.

X.—PROFESSOR THOMAS HENRY HUXLEY, D.C.L., LL.D., F.R.S., &c.

PROFESSOR HUXLEY is undoubtedly one of those great leaders of scientific thought and action who, by the energy and thoroughness of their own work, their perfect honesty in weighing facts in forming their own opinions and considering those of others, and the earnestness and fearlessness with which they express their opinions when formed, so act upon mens' minds as to give a wonderful impulse to the intellectual progress of the world. His own scientific work has been devoted more especially to biological science, and in the departments of physiology, comparative anatomy, and palæontology no name stands more eminent than his; and, by his unflinching support and eloquent exposition of the doctrines of Darwin Professor HUXLEY has done more than any living man to win men to study them, and make them serviceable in scientific thought and research.

And he has worked hard and to good purpose outside the strictly scientific circle and very greatly aided in shaping the educational system of our times so as to bring it more in accordance with the requirements of the age.

Further, Professor HUXLEY has grappled with problems of the here and hereafter from which many men shrink, but which, with that spirit of strict scientific inquiry after truth which he possesses, he has evidently felt himself obliged to follow. But in doing so he has always shown that great reverence, depth and earnestness of feeling, and evident anxiety for truth that should convince even those who are diametrically opposed to his views that he acts only from honest, conscientious motives.

THOMAS HENRY HUXLEY was born at Ealing, in Middlesex, on the 4th of May, 1825, and received the principal part of his school training at Ealing School, where his father was one of the masters. After leaving school, being prevented by circumstances from following the profession of his choice—that of an engineer—he commenced, under his brother-in-law, a physician of some standing, the study of medicine. In following up his medical studies, he attended the lectures of Mr. Wharton Jones, Lecturer on Physiology, at the Charing Cross Hospital Medical School, and this teaching incited him to the earnest study of Physiology and Histology. It is interesting to note that, as a result, he published, when only twenty years of age, an original investigation concerning a new structure in the sheath of human hair, and this structure still continues to bear the name of "Huxley's layer." In the same year he completed his medical studies, and passed the first examination for Bachelor of Medicine at the University of London, taking high honours in Physiology. In 1846 he was appointed to H.M.S. *Victory*, for hospital service at Haslar Hospital, and subsequently, through the interest of Sir John Richardson, the eminent Arctic voyager and naturalist, he was offered the appointment of assistant-surgeon on H.M.S. *Rattlesnake*, which was then, under Captain Owen Stanley, being commissioned for a surveying and exploring cruise to the South Seas. He accepted the position, and very soon made use of the opportunities it afforded for scientific research, for whilst on his cruise he sent home important memoirs on the *Physalia* and *Diphydæ*; also, in 1849, a third paper, on the anatomy and affinities of the *Medusæ*, which was forwarded to the Royal Society, and printed by that society. This gained for him the award of a Royal medal. To the excel-

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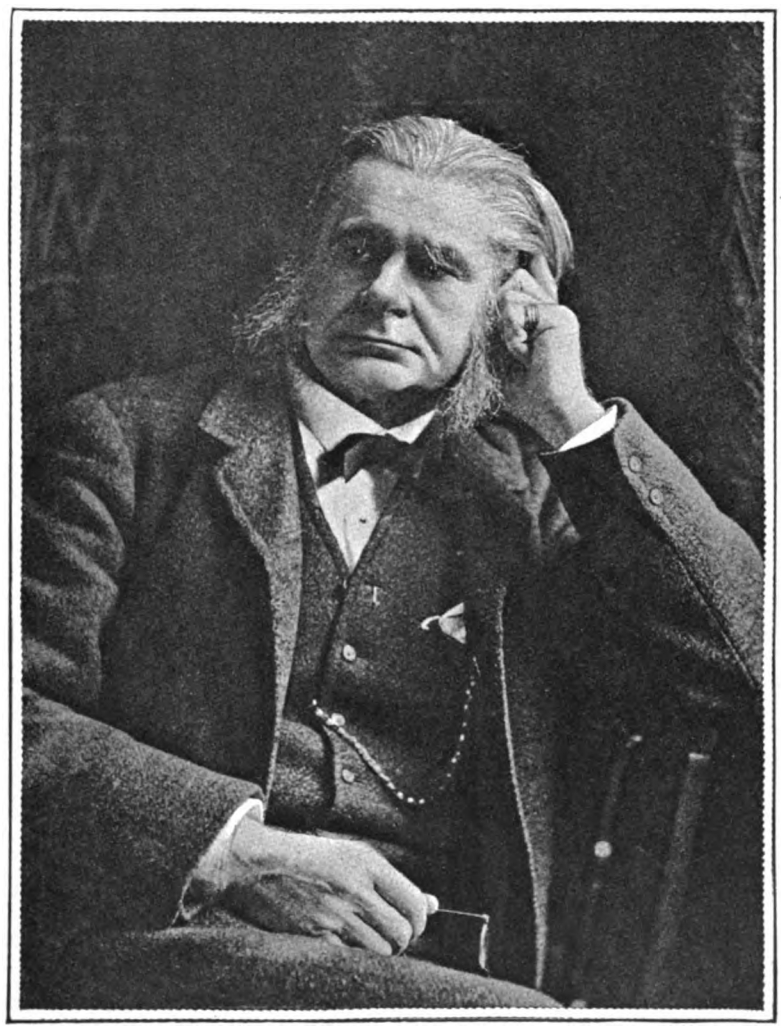

PROFESSOR THOMAS HENRY HUXLEY, D.C.L., LL.D., F.R.S., &c.

From a Photograph by Messrs. Elliott & Fry, London.

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lent teaching of Mr. Wharton Jones, and the incidents of the voyage in the *Rattlesnake*, is due the direction of the studies of Mr. HUXLEY that have made his name so famous. In 1850 he returned to England, but was not idle, for we find him in 1851 submitting other memoirs to the Royal Society, and in June of that year he was elected Fellow of the society, when only twenty-six years of age.

With a good position in the world of science thus early assured he soon made good progress. His maiden lecture was delivered at the Royal Institution in 1852, and in 1854 he succeeded Professor Edward Forbes in the Chair of Natural History (including Comparative Anatomy and Palæontology) at the Royal School of Mines in Jermyn Street, and in that position, by the clearness and earnestness of his teaching, he gave a stimulus to the study of natural history subjects which has had most valuable results; and when in 1872 his professorial duties were transferred to the new buildings at South Kensington, he quickly organised courses of laboratory work which provided that practical teaching in biology without which instruction in that science must always be imperfect and unsatisfactory.

It is, however, impossible in the space at our disposal, to refer to all the important appointments that have been held by Professor HUXLEY, but amongst others, he has been Fullerian Professor of Physiology to the Royal Institution Hunterian Professor of Comparative Anatomy and Physiology to the Royal College of Surgeons; Croonian Lecturer to the Royal Society; Secretary and also President of the Geological Society; Secretary and President of the Royal Society; President of the British Association; Lord Rector of Aberdeen University; Examiner in Physiology and Comparative Anatomy to the University of London; Examiner in Physiology and General Biology to the Science and Art Department, &c. In 1885 ill-health compelled Mr. HUXLEY to retire from the public service; but he remains Dean of the Normal School of Science and Royal School of Mines at South Kensington; and is a Trustee of the British Museum, and a Member of the Senate of the University of London.

His contributions to learned societies have been numerous and valuable. His many published works testify to his industry as a writer and deep thinker. Some of the latter have undoubtedly had a most important bearing upon modern thought. His "Lay Sermons, Addresses, and Reviews," and "Critiques and Addresses," are especially noticeable in this respect. In the former, one essay especially, "On the Physical Basis of Life," brought down upon the author a fierce burst of vituperation and antagonistic criticism. Respecting it he himself says it "was intended to contain a plain and untechnical statement of modern biological thought, accompanied by a protest from the philosophical side against what is commonly called 'materialism.' The result of my well-meant efforts I find to be that I am generally credited with having invented 'protoplasm' in the interests of 'materialism.' My unlucky 'Lay Sermon' has been attacked by microscopists ignorant alike of biology and philosophy; by philosophers not very learned in either biology or microscopy; by clergymen of several denominations; and by some few writers who have taken the trouble to understand the subject. I trust that these last will believe that I leave the essay unaltered from no want of respectful attention to all they have said."* But Professor HUXLEY has lived to see the subject of that "Lay Sermon" considered calmly, even by the very class of persons who at the time of its delivery were his most bitter opponents, but most of whom now see no cause for their attacks.

Two works especially have been serviceable for scientific instruction. "Lessons in Elementary Physiology," ever since its first appearance in 1866, has been a favourite with both teachers and students. All the facts stated in it are clearly and concisely given in language which charms the student, and leads him pleasantly on from one part of the subject to another with exquisite skill. "Physiography, an Introduction to the Study of Nature," is another charming text-book which puts before the student facts connected with natural phenomena in such a manner as to make their study most attractive. This book has, undoubtedly, given great impetus to the intelligent practical study of Nature. Other works, such as "Lectures on Comparative Anatomy," "An Introduction to the Classification of Animals," "Manual of the Anatomy of the Vertebrate Animals," and "The Anatomy of Invertebrate Animals" have also proved extremely valuable as text-books for science students, whilst "A Course of Practical Instruction in Elementary Biology," written by him, with the assistance of Dr. H. R. Martin, and first published in 1875, has given a practical direction to biological study, the value of which cannot be over-estimated.

As a Lecturer Professor HUXLEY has the faculty of speaking of even the most abstruse scientific subjects in a clear, concise, and entertaining manner. He at once rivets the attention of his audience, and every word is easily to be understood. His address as President of the British Association at Liverpool, in 1870, on the subject of spontaneous generation, was a model of scientific exposition, delivered in clear and charming language. And so also his discourse to an audience of working-men on "A Piece of Chalk," and many other lectures and discourses. And the same clearness and charm of manner was always characteristic of his lectures to his students.

As an Examiner Professor HUXLEY deserves the thanks of all friends of scientific education who desire to see examinations something more than mere tests of memory.

* See prefatory letter addressed to Professor Tyndall in "Lay Sermons, Addresses, and Reviews."

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The papers set by him have always been calculated to test real knowledge and discourage what has been termed "cram." To look through questions set by him, one can feel that examinations can be made serviceable in education, and that they need not degenerate to the low and mischievous level that many of them now occupy.

Professor HUXLEY has acted upon several Royal Commissions, and his labours in the Sea Fisheries Commission will be ever remembered.

In connection with educational matters, he not only worked hard for about a year on the London School Board, doing valuable service, until his health gave way, but he has discoursed and written with vigour on various educational topics; and amongst his published addresses the following will repay careful perusal:—"On the Advisableness of Improving Natural Knowledge;" "A Liberal Education: and Where to Find it," "Scientific Education; Notes of an After-Dinner Speech," and "On the Educational Value of the Natural History Sciences," all of which will be found in the volume of "Lay Sermons, Addresses, and Reviews." His article from the *Contemporary Review*, published in "Critiques and Addresses," on "The School Boards: What They Can Do and What They May Do," also shows clearly how fully he has studied the subject.

It seems to be impossible to write of Professor HUXLEY without referring to his views on subjects connected with religious belief, and respecting which he is too often misrepresented; but if one may judge of his springs of action in regard to these great questions by what he himself has from time to time expressed, we cannot but feel how strictly conscientious he is in the views he holds. In his address "On Descartes' Discourse Touching the Method of Using One's Reason Rightly, and of Seeking Scientific Truth," he says "The central propositions of the whole 'Discourse' are these:—There is a path that leads to truth so surely that anyone who will follow it must needs reach the goal, whether his capacity be great or small. And there is one guiding rule by which a man may always find this path, and keep himself from straying when he has found it. This golden rule is—Give unqualified assent to no propositions but those the truth of which is so clear and distinct that they cannot be doubted." And it seems, as we note the position he has taken up, that such rules as these guide his own conduct in his earnest seeking after truth.

In this article we have been unable to speak of many matters pertaining to Professor HUXLEY's long and active career, but of him it may be truly said that to Science he has rendered service of the utmost value, and that his whole life has been a life of usefulness to his fellow-men.

A. N. T.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between February 16th and March 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board:—

(*a*) Barometer	Highest (March 15th)	30·57	Inches
,, ,,	Lowest (March 8th)	29·24	,,
,, ,,	Mean	30·027	,,
,, ,,	,, for 22 years February	29·928	,,
,, ,,	,, ,, March	29·923	,,
Temperature	Highest (February 16th)	52·3	Deg. F.
,,	Lowest (March 3rd)	25·4	,,
,,	Mean	38·2	,,
,,	,, for 22 years February	41·0	,,
,,	,, ,, March	41·8	,,
,,	,, of Evaporation	36·0	,,
,,	,, ,, for 22 years February	38·9	,,
,,	,, ,, March	39·1	,,
(*b*) Rainfall	Amount	1·267	Inches
,, ,,	,, Mean for 22 years February	1·669	,,
,, ,,	,, ,, March	1·712	,,
,,	Number of Days on which Rain fell	16	
,,	Greatest fall in 24 Hours (March 7th)	0·617	Inches
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·6	
,,	,, ,, for 22 years February	7·2	
,,	,, ,, March	6·5	
(*c*) Wind	Velocity, Greatest (February 16th)	46	Miles.
,,	,, Least (February 22nd)	1	,,
,,	,, Mean Hourly	15·2	,,
,,	Greatest Pressure on Square Foot (Feb 20, 11·30 a.m.)	25·0	Pounds.
,,	Direction at time of Greatest Pressure	W	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
76	90	96	43	42	171	100	54	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

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Bolton.

During the week ending February 21st the weather was mild, on two days the maximum in the shade exceeding 50°; barometric pressure unsteady, but above the average; 4° of frost registered on the 16th: owing to the Westerly winds the average proportion of ozone for the week was 4·5 (scale 0—10). The averages or totals were:—Barometer 30·123″; corrected mean temperature 40·86°; humidity (0—100) 86·; rainfall 0·51″; bright sunshine 11 hours 50 minutes; prevailing wind W. From the 22nd to the 28th pressure was again unsteady; mean temperature low, with six frosty nights; slight snow fell on the last three days, and ice-crystals on the 24th and 25th; no rain fell. Averages:—Barometer 30·048″; corrected mean temperature 33·81°; humidity 83·6·; rainfall (snow) 0·052″; bright sunshine 3 hours 38 minutes; prevailing wind N.

The following are the means or totals for the whole month of February:—Barometer 29·908″, range 1·241″, oscillations 19; corrected mean temperature 36·7°, range 22·35°; humidity 85%, range 30°; rainfall 2·715″; bright sunshine 53 hours 39 minutes, or 20·5% of the time the sun was above the horizon; prevailing wind Westerly; gales occurred on the 2nd, 3rd, and 8th.

During the week ending March 7th pressure was pretty steady until the 6th, when a depression from the S.W. set in; temperature continuously low, with more or less frost each day until the 7th, and

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occasional slight showers of snow; foggy on the morning of the 4th. Averages:—Barometer 29·93″; corrected mean temperature 31·91°; humidity 81°/₀; rainfall 0·172″; bright sunshine 5 hours 35 minutes; prevailing wind N.E. On the 8th the cyclone from the Channel became deeper, passing along the S. of England and Midlands towards Scandinavia, producing heavy floods along its way. In Herefordshire 3·3 in. of rain fell between the 6th and 8th, and at Loughborough, in Leicestershire, on the 8th 2·1 in. fell in 24 hours. At Bolton the barometer was 29·17 in. at 9 p.m. on the 8th, and the day's rain and snow was 0·706 in. Since then the pressure has gradually increased to 30·386″; the temperature has been milder and weather more settled. Averages:—Barometer 29·9 in.; mean temperature 39·2°; humidity 86°/₀; rainfall 1·036″; bright sunshine 21 hrs. 50 mins.; prevailing wind W.

The following are the accumulated amounts of growing temperature and rainfall at Bolton from the 1st January to the 14th March during the last three years, compared with the average at Marlborough for a period of 20 years during the same days:—

	1887.	1888.	1889.	Marlborough.
Accumulated temperature	201·4°	130·4°	142·9°	170·6°
Rainfall	3·670″	6·673″	5·752″	7·261″

From this your readers will observe that vegetation and moisture are both below the average, but not to such an extent as the moisture was in 1887 or the growth in 1888. W. W. Midgley, F.R.Met.S.

Met. Observatory, Bolton, March 18, 1889

Sheffield.

February, 1889.	TEMPERATURE.					* Means for February.		RAINFALL.					* Mean for Feb. Ins.
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Daily Max.	Daily Min.	Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.		
Sheffield ...	56°	1st	23°	11th	39°	—	—	2·01	15	0·43	6th		—
Spurn Head.	52°	1st	25°	10th	37°	—	—	1·10	20	0·19	11th		—
York	55°	1st	21°	10th	37°	45°	34°	1·02	17	0·16	3rd		1·88
Barrow	50°	1st	24°	11th	39°	—	—	2·35	17	0·37	13th		—
Liverpool ...	55°	1st	22°	11th	39°	45°	37°	2·09	18	0·64	6th		1·85
Holyhead ...	52°	16 & 17	29°	11th	41°	46°	39°	1·99	20	0·38	12th		2·90
Oxford	54°	17th	20°	12th	37°	46°	36°	1·82	18	0·44	10th		2·06
London	58°	17th	21°	12th	37°	47°	36°	2·32	18	0·51	10th		1·89

* The means of Temperature and Rainfall for February are for 15 years.

February 16 to March 15, 1889.

Pressure.

On the 16th February pressure was low, 29·6 in. in the N., but as high as 30·2 in. in the S., and it had increased very little on the 17th, but on the 18th it had risen to 29·9 in. in the N. and 30·4 in the S. On the 19th the barometer was above 30·0 in. all over the kingdom, but fell slightly in the N. on the 20th, remaining high elsewhere, the isobars during all this time remaining from W. to E. On the 21st the isobars ran from N. to S. and pressure was above 30·0 in. in all places, and it continued above 30·0 in., though changing locally, till the 26th, when it fell to 29·8 in. in the S. and 29·9 in. in the N. Pressure was low but tolerably even all over the kingdom on the 27th, and rose generally on the 28th, but was still below 30·0 in. On March 1st it ranged between 29·8 in. in the S. and 30·1 in. in the N., falling slightly on the 2nd and 3rd, and rising a little on the 4th, with another slight fall on the 5th, and a very decided fall to 29·5 in. in the N. on the 6th, with rather close isobars ranging to 30·1 in. in the S. On the 7th there was a further fall, caused by a deep depression in the S.W., and the barometer ranged from 29·3 to 29·5 in. The depression advanced slowly on the 8th, and the barometer ranged between 29·2 and 29·3 in., and on the 9th the depression had passed to the E. of our coasts and pressure was recovering, but it was still low. On the 10th there was a further increase of pressure, which ranged from 29·5 to 29·7 in., and on the 11th it had risen to 30·0 in. in nearly all places, rising above 30·0 in. on the 12th and remained high on the 13th, 14th, and 15th, when it ranged from 30·3 to 30·5 in.

The Weather.

From February 16th to the 22nd the weather varied considerably, being mild during the early part of the time, and fine in the South and East, but wet in the North and West, and during the latter part it became cold, with sharp frosts and snow showers in places. There was rain on five days at Barrow and Liverpool, four at Spurn, Holyhead, and London, three at York and Oxford, and two at Sheffield. During the week ending March 1st the weather was of a very quiet nature, continuously cold, with showers of soft hail and sleet in some places, but generally bright and fine. There was rain or snow on seven days at Spurn, five at Sheffield, York, and London, four at Holyhead and Oxford, three at Liverpool and Barrow, but the total amount did not reach a quarter of an inch at any of these places From March 2nd to 8th the weather changed considerably, and until the 6th it was generally dry, and temperature very low, with keen frosts, but afterwards the air became warmer. On the 7th and 8th there were heavy falls of rain and snow in all parts of the country, and serious floods followed. On the 8th the rainfall was above two inches at Loughborough, and exceeded an inch at Sheffield, York, and several other places There was rain on six days at Holyhead, four at York, Barrow, and London, and three at Sheffield, Spurn, Liverpool, and Oxford. The following week, from March 9th to 15th, the weather, on the whole, was fine and dry, with low temperature and keen frosts in the early part of the week, and milder, with slight showers, towards the close. There was rain on five days at Liverpool, three at Holyhead, two at Spurn and Barrow, and one at Sheffield, York, London, and Oxford, but it was light at all places, the heaviest fall being at Liverpool, and only amounting to 0·13 inch for the week.

Sun Spots.

Observations were made when the sun was visible from February 16th to March 15th. On February 21st the sun was spotless. On the 23rd a spot of moderate size, closely followed by a group of seven or eight smaller ones, was visible above the equator, and about one-sixth the diameter of the disc from the eastern limb. On March 2nd the sun was again spotless, and also on the 4th, but on the 5th there was a spot surrounded by bright faculæ, and followed by other faculæ very near to the eastern limb. The spot appeared to be elongated from N. to S., but this was probably due to foreshortening, for on the 9th the spot was much further advanced on the disc, and appeared quite circular, with well-marked nucleus and penumbra. On the 11th the spot appeared unchanged and was further on the disc, and on the 12th the same spot was visible, and there was another one, smaller, and about a degree behind and above it. On the 15th both spots were still visible and near the western limb, the first of them having a very small spot apparently touching the penumbra on its eastern side, and the other with a small spot almost touching and a little to the south of it.

Astronomical Occurrences in April.

The moon was new on the last day of March, enters its first quarter at 1-47 p.m. on April 8th, is full at 10-19 p.m. on the 15th, attains its last quarter at 1-56 p.m. on the 22nd, and is new again at 2-5 a.m. on the 30th. There will be an occultation of a fourth magnitude star in Taurus, its disappearance occurring at 10-18 p.m., and will be below the horizon at the time of reappearance. On the 5th a 5½ magnitude star in Taurus will be occulted at 6 37 p.m., reappearing at 7-53 p.m. Venus will be a brilliant object in the early part of the month, setting on the 1st at 10-30 p.m., but setting earlier each night, and as it comes into inferior conjunction with the sun soon after midnight on the 30th it will afterwards be a morning star. Mars is still an inconspicuous object, setting about 8-30 each evening. Jupiter rises at 1-55 a.m. at the beginning of the month and a few minutes after midnight at the end, and is now a bright object in the early morning sky. Saturn is high up in the sky at sunset, and does not set until 4 a.m. at the beginning of the month and at 2-15 at the end. E. Howarth, F.R.A.S.

Museum and Observatory, Sheffield, March 20, 1889.

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Societies.

BIRKENHEAD LITERARY AND SCIENTIFIC SOCIETY.—At a meeting held on March 4th, a paper was read on "Darwin and the Origin of Species," by Mr. J. H. Ziegler, of which the following is an abstract:—For a period of nearly 100 years before the publication of the "Origin of Species," a few naturalists in a speculative manner had propounded the theory of the transmutation of species. Darwin, in the "Historical Sketch" with which he prefaces the "Origin," quotes passages to show that Aristotle, as he looked upon the various parts of an organism, saw in them "adaptations to an end," but it is safe to conjecture that of our modern view of species the ancients possessed no foreshadowing. In modern times the first work dealing with the subject was one entitled "Telliamed," by Benedict de Maillet, a Frenchman, published in Egypt in 1735. De Maillet held that all forms of life have arisen by natural process, though he had no fixed idea of the determining causes. "Zoonomia," by Dr. E. Darwin, published in 1794, was, as Professor Nicholson observes, the first expositor in any systematic form of the transmutation theory. Its special value lies in the fact that to a certain extent it foreshadowed the modern evolution theory. Erasmus Darwin anticipated many of the views and erroneous opinions of Lamarck, who, in his "Philosophie Zoologique," worked out with greater elaborateness and with truer scientific precision the mutability doctrine. Both naturalists, however, constantly ascribed to a "final cause" what Charles Darwin would have regarded as a result. The "Vestiges of Creation," published by Chambers in 1844, paved the way for the "Origin." It broke down the fabric of preconceived ideas, but failed utterly at the work of reconstruction, and in many respects was a retrogression from the views even of E. Darwin and Lamarck. The universal opinion during the first half of this century was that species were miraculously created with a "determinate and invariable organisation," that they were specially adapted to their own region, and that they were incapable of material modification. The anthropomorphic view is antagonistic to many well-established scientific facts, and is not supported by any single fact. We are bound to reject higher causes for a given result where lower ones are found sufficient to explain observed phenomena. Rudimentary organs were shown to be inexplicable on the theory of design, and the fact that one half the animal kingdom is parasitic negatives the idea of a Beneficent Creatorship. The Darwinian theory was then somewhat minutely detailed. It was shown how all individuals of the same species tend to vary; the causes, so far as can be ascertained, of this variability were given, viz., functional changes in parents due to varying conditions of life, the inheritance of acquired habits in the parents, and the use or disuse of parts tending to become inherited. This law of variation stands in direct relation to another law of nature, viz., the high rate at which all organic beings tend to increase. This, in turn, was shown to bring about a "struggle for existence," with the inevitable result that all individuals best fitted to live would survive. The complex relationship of all organisms, one to another was then shown, the probability that any favourable variation tending to benefit the individual would be seized upon by Nature, and the individual possessing it "selected" to survive, which, according to the law of heredity, would be handed down to progeny. The arguments from Morphology and Palæontology were somewhat extensively considered. The example of the insect kingdom, as instanced by Spencer, having primarily twenty segments, was shown to point to the evolution hypothesis. The vetebral column, also is different in the snake and bird, in the one so well adapted to its movements over the ground, in the other the vetebral fused into a fulcrum to support the bird in its flight. Palæontology was shown to speak loudly for the theory. It was ointed out how positive evidence under this head must be implicitly followed, while, on the other hand, negative evidence is worthless. The reasonableness of Darwin's contention that the geological record is incomplete was dwelt upon, while subsequent discoveries went to prove evolution to be true. Igneous action, it was shown, has largely obliterated fossil remains. A spirited discussion ensued. Mr. Oelrichs, who moved a vote of thanks to the author, avowed himself a believer in evolution; the only missing link he believed in was that between inorganic and organic life. Mr. Gostenhofer and Canon Saumarez Smith opposed the views of the paper. The latter characterised Darwin's conclusions as unphilosophical and not proved, while, on the other hand, Mr. Alsop supported the theory.

CLYDESDALE NATURALISTS' SOCIETY.—The ordinary monthly meeting was held on Wednesday evening, 20th March, in the society's rooms, 207, Bath Street, Glasgow, Mr. Robert J. Bennett, vice-president, in the chair. Mr. James Lumsden, of Arden, F.Z.S., president of the society, exhibited two stuffed specimens of the Common Crossbill, *Loxia curvirostra*, recently killed in Dumbartonshire from a considerable flock, and read some interesting notes on the occurrence of this and the allied species known in Scotland, three in number, though the best authorities are now inclined to think that two of these are mere varieties from differences of sex and plumage. In his remarks Mr. Lumsden spoke of the folk-lore and legendary stories attached to the Crossbill. A number of European specimens were exhibited by Mr. George E. Paterson; also a nest with eggs of the Common Crossbill, taken in East Rossshire on 21st March, 1881. Three fine living specimens of the same species, probably from Germany, were kindly lent for exhibition by Mr. Peter Muir, bird dealer, St. Enoch Square. Mr. Thomas J. Henderson exhibited a fine series of the lepidopterous genus from *Noctua*, giving some details of the distribution of the various species in the British Islands. Mr. George E. Paterson exhibited a magnificent stuffed group of the Wild Cat, *Felis catus*, with kitten and bird, recently trapped in Sutherlandshire, where, although formerly common, this animal may be now classed as rare. Mr. George S. M'Kenzie exhibited spawn of the Common Frog, just hatching, which is considerably later than last year. Some few weeks ago it had been frozen solid, but that did not seem to have destroyed its vitality. Mr. James B. Murdoch, F.R.Ph.S.E., read a paper entitled "Notes on the Chough and other members of the Crow Family," which was illustrated by some fine skins of different species. It was remarked regarding the Chough, or Red-legged Crow, that the numbers of that graceful and active bird, once widely spread over Scotland, had been decreasing for many years, until now, except in a few favoured localities on our rock-bound coasts, it might almost be called extinct. Some authorities seemed inclined to blame its congener, the Jackdaw, as the cause of its disappearance, but Mr. Murdoch said he was not prepared to assent to this charge without more distinct proof than was at present forthcoming, the mere fact that, frequenting the same habitats, the Jackdaw had thriven while the Chough had almost vanished, not being sufficient evidence. Respecting the Rook, or, as it is popularly known in Scotland, the Crow, there had lately been a considerable outcry as to its alleged destructive habits in corn and potato fields. While admitting that at certain seasons of the year it undoubtedly did some mischief, Mr. Murdoch contended that any loss sustained by the farmer in that way was far more than compensated for by the great benefit it rendered him in devouring immense quantities of worms, grubs, and insects, especially the larvæ of the wire-worm and the "daddy longlegs." He was afraid, however, the Rook could not be absolved from the charges of egg stealing, and even of killing young and weakly birds. These habits seem to have become more thoroughly developed in recent years. An interesting discussion followed, and was taken part in by Messrs. George H. Reid, Lumsden, Clavering, and Eggleton, the latter

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remarking incidentally that only one nest had, as yet, been built at the rookery in Kelvingrove Park this season, though two years ago there had been as many as eighteen nests. He thought that this proceeded not from the proximity of the houses, but from the fact that the larger trees were decaying in their upper branches.

EALING MICROSCOPICAL AND NATURAL HISTORY SOCIETY.—A CENTURY OF PROGRESS IN FLORICULTURE.—At the annual meeting of this society on Saturday, February 23rd, a lecture on "A Century of Progress in Floriculture" was given by the president (Rev. Professor Henslow), who illustrated his subject by a number of prints of the various forms of the flowers touched upon. He first referred to the pelargonium, observing that its home was the Cape of Good Hope. Of species which played an important part in modern floriculture, the first to be imported were zonale in 1710, and inquinans in 1714, the latter being cultivated for their variegated foliage. The ivy-leaved pelargonium came over in 1701, and of this a print was shown, the first drawing of the flower having been made in 1787. Other species were imported sparingly during the early part of the eighteenth century. These were all small, and the gardeners proceeded to hybridise. They would take two forms and cross them, and the result invariably was an improvement. At the beginning of this century one came over which laid the foundation of all our large-flowered or fancy pelargoniums, and this was called the *Pelargonium grandiflorum*. The gardeners now took the grandiflorum and some smaller ones, and crossed them with numerous hybrids, and subsequent crosses had been raised since, but those first formed early in the century were insignificant, and probably now lost to the cultivator. As to the form of the flower, the original shape was mostly very irregular, the posterior petals being often much the larger, while the stamens were declinate, the sub-genus (*Hoarea*) having lost the anterior petal. This was almost an invariable rule, and he offered a theory to account for it. He had given it once in that room, and it appeared in his book on the *Structure of Flowers*. When the insects went to flowers they mus rest upon them, and as a rule they alighted on the front petals, and whenever they did that—it did not matter what the flower was—the petal was invariably enlarged, so that it formed an excellent landing place for the insect; but supposing there was no petal underneath, and they stood on the stamens, their weight was no longer on the front petals, and only the posterior petals behind the nectary were stimulated to extra growth. In other words, when the insects alight on the petal in front they were always larger, and when on the stamens, and no, on the petals, they were always smaller. This theory also accounte for mimetic resemblances in flowers, in that similar insects visiting different flowers the latter responded to them, and so gave rise to forms having a strong external resemblance to one another, but with no real affinity. The lecturer came next to the fuchsia. The first introduction of the flower was not, he said, exactly known. The fuchsia they knew in their gardens one might see in Cornwall forming hedges, and even trees; it had a long, pendulous flower, and was known as *Fuchsia coccinea*. But lately it had been found that this was not entitled to that name at all. It was regarded as having been introduced in 1788. All the fuchsias came from America, with one or two exceptions from New Zealand. Sir Joseph Hooker found this was not the true *Fuchsia coccinea*, which came over about the same time, if not before, and he figured it in the *Botanical Magazine* some years ago. The *Fuchsia coccinea* was really the *Fuchsia Magellanica*, and came from the south of Chili, and was hardy in the warmer parts of Great Britain. The President showed specimens of it on a sheet of paper, which he said had belonged to the Professor of Botany at Cambridge preceding his father. Several other varieties came over at the beginning of this century. The *Fuchsia Magellanica*, however, from the Straits of Magellan, was exactly now as it was then, not having, it seemed, altered at all. He mentioned, as an instance of curious crossing, the *Fuchsia fulgens*, which came over from Brazil in 1837, and which was crossed by globosa, and by this means had been raised one of the best hybrids of those days—the *Fuchsia Standishii*, this being between two such extremely different species as fulgens and globosa. The Calceolaria was next dealt with, it being observed that this genus, like the fuchsia, had its home in South America, and came over at the beginning of this century, and it was curious that calceolarias were also found in New Zealand as well as fuchsias. Having shown how four species were introduced in 1822 with yellow flowers, and a purple followed in 1827, the lecturer went on to say that in 1831 the *Calceolaria crenatiflora* was introduced, having a yellow corolla spotted with crimson, and a deeply crenated "slipper." This species, as well as the *Calceolaria integrifolia*, and its varieties, *augustifolia* and *viscosissima*, imported in 1831, laid the foundation of the subsequent innumerable forms. The results of the crossing of these species were that either yellow or purple became the ground colour, the other forming a large spot upon it, or else they combined, producing scarlet, &c. The additional aid afforded by the *Calceolaria crenatiflora* furnished the variously-spotted forms now in cultivation. The shape of the corolla first aimed at was circular, but of late years this had passed into a more ovoid type, while the size had increased enormously, so that by calculating the cubic capacity of one of Mr. Carter's "Japanese" and "Victoria" calceolarias, and comparing it, he found that it contained about twelve times the volume of the slipper of the original species. As to petunias, the three species which contributed to the formation of our present garden varieties was *Petunia violacea* (purple), 1831; *Petunia nyctaginflora* (white), 1823; and *Petunia bicolor*, all coming from Brazil. The last species was the origin of hybrids of a tender nature, and originated the dark-mouthed and streaked kinds, having been crossed with the *Petunia nyctaginflora*. The remarkable fact was pointed out that for many years no double specimens could be raised, but in one year they appeared in France, Germany, and England at once. The dahlia next occupied attention, it being remarked that this was the centenary of the flower, which was found growing wild by Humboldt, at an elevation of from 4,800 to 5,600 feet, in sandy meadows in Mexico. It had long been grown in Mexican gardens, and was first introduced to Madrid in 1789. It was taken to France in 1800, and was brought to England by the Marchioness of Bute in 1789. But it was lost, and Lady Holland re-introduced it in 1804, from Paris. All the varieties had arisen since 1802 in France and 1804 in England. The first indication of doubling appeared to have been in a semi-double variety produced in Madrid in 1790. Many sorts were introduced into England after the war, from France, subsequent to 1814. It was first figured in the *Botanical Magazine* in 1814, both single and double. At that time only five varieties were known, viz., red, purple, lilac, pale, and yellowish. In 1879 Mr. Cannell, of Swanley, introduced a new form which he called "cactus" dahlias, and the cactus dahlia of to-day was but little different from the first kind of doubling known. The dwarf kinds were raised in Germany previous to 1850, but not introduced into England till about 1860. In speaking of chrysanthemums the lecturer said according to Hooker we had three specimens in Great Britain—the *Chrysanthemum segitum*, the corn marigold; *Chrysanthemum leucanthemum*, the ox-eye daisy; and *Chrysanthemum parthenium*, fever-few; while Bentham would include species of *Matricaria*. The two species furnishing the ordinary chrysanthemums were the *Chrysanthemum indicum* of Linnæus and *Chrysanthemum sinense* of Sabine. These had been cultivated for ages in China and Japan, but the first notice of their European culture appeared to have been by Breyn, of Dantzic, in 1688. A plant of *Chrysanthemum indicum*, with small and single yellow flowers, was grown in Chelsea garden in 1764, but lost. Blancard, in 1789, grew a white, purple, and violet-coloured kind at Marseilles. From him Mr. Colville, of the King's-

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road, procured the purple sort, and grew it for the first time in England in 1795. In 1846 Mr. Fortune introduced the two small-flowering kinds, called the Chusan daisy and Chinese minimum, which probably originated from *Chrysanthemum indicum*, and were now the source of all the pompons. In 1860 no less than 750 varieties were known. In that year Mr. Fortune introduced the long-pointed, petalled Japanese forms. He procured several varieties and left them at Shanghai while he went to Pekin, but on his return he found they had perished, with the exception of two or three. These he sent over to Mr. Salter, of Hammersmith, who cultivated them and got them to grow, and from seeds raised the same quaint forms which Mr. Fortune had lost. The curious Japanese forms one saw now were the results of the species that came over in 1861, and the size had much increased. We had probably not got to the limit of the chrysanthemum yet. The hyacinth was last touched upon, it being shown that a wild form of this flower grew in this country in 1580, and was figured in 1597 by Gerarde, and it was remarkably like the wild forms of the present day. It was a native of the Levant, and abundant about Aleppo and Bagdad, growing also near Nice and Toulon. Singles only were cultivated at first, and it was not till the beginning of the last century that doubles were raised. In 1842 Dr. Lindley observed that a yellow hyacinth was an impossibility, but a few years later there were plenty of yellow hyacinths. Where the first yellow one came from he did not know, but it broke through the old theory, and we might upon the same principle some day, perhaps, have a blue dahlia and a blue rose even, although these had resisted all efforts at present. Upon the motion of the Rev. Percy Myles, seconded by Mr. J. Allen Brown, a hearty vote of thanks was given to the president for his address.—On March 9th a lecture on "Migrations of Birds" was given by Mr. H. Seebohm, F.Z.S., of which we hope to give abstract in our next issue.

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Liverpool Biological Society.—The sixth ordinary meeting of the society was held at University College, on Friday, March 8th, 1889. The reports on the flora and fauna of the Liverpool district read consisted of the algæ, copepoda, and higher crustacea. These reports seem to show how practically inexhaustible this study is. When the work of collecting and describing was started by the society some four years ago it was thought that the work would be practically complete in a year or two, but as years go on the number of species annually found increases rather than diminishes. The report on the higher crustacea, by Alfred O. Walker, F.L.S., described 27 new species (5 Podophthalmia, 3 Cumaceae, 4 Isopoda, and 15 Amphipoda). Two of the species are new to the British Isles. They were chiefly collected at the Puffin Island Station and in the dredgings on the "Hyæna," when the electric light was used as a bait. The report on the copepoda, by Mr. I. C. Thompson, F.L.S., described 20 new species (5 new to Britain, and 2 probably new to science). The report on the algæ, by R. J. Harvey Gibson, M.A., F.R.S.E., being the first report on the algæ, described all the species known to exist in the district, 232. Of these 220 have already been described by Mr. Marrat, 5 by Mr. Leicester, and 7 are new. All these reports are published in full in the proceedings of the Liverpool Biological Society, and all the new species are there figured. An interesting discussion arose out of these reports, and Mr. Walker proposed that a committee should investigate how it is that, seeing the abundance and variety of the fish food of the bay, fish are annually becoming more and more scarce. He argued at some length that this is due to the "Wild Birds' Preservation Act," under which gulls and cormorants have so rapidly increased that they are steadily consuming all the fish in the district. The following short notes were also communicated:—"A Peculiarly-shaped Dead *Alcyonium Digitatum*, with the Tubes Filled with Crustacean Eggs," by H. C. Chadwick. "On the Healing of Accidental Fractures and Amputations in Frogs," by the Secretary (Dr. Larkin). "On a Peculiar Lemon Tending to Revert to the Apocarpous Type," by R. J. Harvey Gibson.

Liverpool Marine Biological Committee.—Under Professor Herdman's direction, the curator of the Biological Station at Puffin Island has been lately engaged in making certain measurements and marking off certain areas on the shore, with the view of facilitating the work of subdividing the littoral zone into a series of regions characterised by the presence of particular species of animals and plants. The further work in connection with this "zoning of the shore" will be not merely a matter of identifying species and of marking out their localities, but will also involve some interesting physiological problems in connection with the changes in the respiration and nutrition of some of the animals, which probably go on during their periodic alternate exposure to air and immersion in the sea. A new window has been made in the Puffin Island Station, which will considerably increase the usefulness of one of the rooms. The station will be filled with workers at Easter time and for a week or ten days beforehand, but there is still room for a few students at the beginning and at the end of April, and during the remainder of the season.

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University College, Liverpool.—During the summer term there will be junior and senior classes of practical zoology, on Wednesday evenings, commencing May 1st. Advanced students, who wish to do any special work, are invited to apply to Professor Herdman, and all possible facilities will be given to them for carrying on investigations in the laboratory. The junior class, in which no previous knowledge will be required by the students, will dissect and examine microscopically—*Actinosphærium*, or some other protozoon, *Hydra*, and some of the hydroid zoophytes, *Alcyonium*, the earthworm, the cockroach, the mussel, and the frog. The senior class, for students who have already gone through a junior course of practical zoology, will probably examine some of the hydroid zoophytes, sea-anemone, one of the echinodermata, an annelid, some polyzoa, the crab, the snail, and an ascidian. A research class, open to advanced students able to carry on original investigations under supervision, will be arranged at a time to suit the convenience of students. There will also be, in connection with these classes, a few excursions for field work on Saturday afternoons.

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The United Field Naturalists' Society, Manchester.—The quarterly meeting of this society was held on Sunday, March 10th, at Middleton, in the large room belonging to the Liberal Club. Mr. William Horsfall, Manchester, one of the vice-presidents, occupied the chair, and there was a good attendance of members from the surrounding towns. A few wild flowers were shown, some superb hothouse flowers, and a small collection of geological specimens. Mr. Joseph Chappell, Manchester, exhibited and described a number of rare and beautiful beetles, butterflies, and moths; Mr. Councillor Thorpe, J.P., Middleton, a large collection of silk and other moths, with cocoons, many of them very rare; the death-watch beetle, showing how it damages silk when wound upon the bobbin; nests of the trap-door spider, and butterflies. Also a number of drawings exhibiting the life-history of bees, wasps, and beetles. In the afternoon Mr. William Horsfall gave a lecture, entitled, "Do Animals Reason?' He quoted most of the standard authorities on the subject, and contended that many of the lower animals possess reason the same in kind as man, but less in degree. Mr. Horsfall gave a number of well-authenticated instances in support of his argument, and his lecture was followed by a lengthy and interesting discussion.

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Sheffield Naturalists' Club.—At the monthly meeting of this club, on March 15th, Mr. E. Howarth, F.R.A.S., president, occupied the chair, and H. C. Sorby, Esq., LL.D., F.R.S., delivered a lecture on "The Habits of Certain Mollusca," being the result of observations made on board his yacht, on the coast of Essex and Suffolk, last summer, in which some interesting and probably unknown facts in the

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habits of certain mollusca were discovered. After describing the method adopted to obtain the living mollusca by searching for them in the mud, Dr. Sorby stated that specimens of *Mya*, *Scrobicularia*, *Tellina*, *Cardium*, and *Pholas* were obtained alive and placed in the aquarium on board his yacht and some of the mud in which they had been found was placed in the aquarium with them, so as to conform as nearly as possible to their natural conditions. *Mya* occupied nearly a day in burying itself in the mud; *Cardium* about an hour; and *Pholas*, when placed on its side on the top of the mud, was apparently incapable of any effort to bury itself; but when an indentation was made in the mud, and the anterior margin of the shell placed in it, it slowly disappeared. By leaving about an inch of water above the surface of the mud, the currents from the inhalant and exhalant siphons could be plainly seen, and the habits of *Cardium* and *Mya* were in accordance with previously-known facts, they obtaining their food from the currents of water which passed through the siphons in respiration; but in the case of *Scrobicularia* and *Tellina* a totally different method prevailed, and one that has apparently not been previously observed. When placed on the mud, *Scrobicularia piperita* almost instantly buried itself by means of its well-developed muscular foot, and after a time what appeared to be a worm was seen wriggling about the surface of the mud. This, however, proved to be the inhalant siphon of the mollusc, which was extended to a length of 8in., and it made a hollow in the surface, the siphon becoming filled with mud, which was passed through it into the body cavity, the mud being afterwards discharged in small coils by the same siphon. This went on rapidly, the siphon being filled and emptied again about every four minutes. After a day or two, when the surface of the mud in the aquarium had become rather stiff, the siphon was not protruded, but through the glass in the tank the mollusc could be seen working in the same way in the soft mud below, and discharging the mud from the siphon with such force as to blow it above the surface like a volume of smoke. Evidently the mud was taken into the body for the purpose of extracting from it any food that it contained, and this was probably done by the labial palpi, but by what means the mud, when in the body cavity, was prevented passing into the gills Dr. Sorby had not been able to discover, but hopes to be able to make further observations in the coming summer. The lecture was illustrated by lantern views prepared from drawings made by the lecturer, who also pointed out how the changes in the coast-line were indicated by masses of dead shells found in mud, now far removed from the present high-water mark.

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Wells (Somerset) Natural History and Archæological Society.—The second meeting of this new society was held on February 21st, Dr. Livett in the chair. Canon Church gave an interesting history of the "Old Archdeaconry" of Wells; and the chairman read a paper on "A Few British Orchids," contributed by the Rev. T. A. Preston, author of "The Flowering Plants of Wiltshire." Afterwards Miss Livett announced that she was about to hold a class in botany for members of the society. Such a step cannot but prove extremely serviceable in assisting the members to study the extensive flora of this charming neighbourhood.

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Yorkshire College Society of Chemists and Colourists.—At the meeting held on February 28th, Mr. W. M. Gardner in the chair, Mr. James Whitehead read a paper on "Benzidine and Allied Colours," in the course of which he said:—The benzidine colours belong to the large class of bodies known as the azo dyes, all of which are prepared according to one general method, viz., by acting on diazo compounds with phenols, amines, &c., of the aromatic series. These azo colours are to be considered as derivatives of benzene, naphthylamine, &c. The azohydrocarbons are obtained from the original hydrocarbons by substituting an azo group ($-N=N-$) for a hydrogen atom, and such azo bodies give rise to colours by combination with aromatic amines, phenols, &c. Until about the year 1885, none of the azo colours then on the market possessed the remarkable and characteristic property of dyeing cotton without the aid of a mordant. About this time, however, the attention of dyers was especially directed to a new series of colours derived from benzidine, which, although sulphonates, did possess this valuable property and were essentially cotton colours. Dr. Griess discovered the first colour of this class in 1882, but from some reason it did not appear in the market. Shortly afterwards Bottger patented Congo red, and the manufacture of it was taken up by the Actien Gesselschaft fur Anilin Fabrik, Berlin. Since that time, at short intervals, the various colours in this class now at the disposal of the dyer have been introduced. They are derived chiefly from benzidine, a few of them from stillbene.

Benzidine possesses the formula as represented thus— $\begin{matrix} C_6H_4NH_2 \\ | \\ C_6H_4NH_2 \end{matrix}$ diamido-diphenyl.

It may be obtained from nitrobenzene by the following reactions:— By treating an alcoholic solution of nitro-benzene with caustic soda and zinc dust it is converted into azobenzene—

$$2\,C_6H_5NO_2 + 2\,H_2 = (C_6H_5N=NC_6H_5) + 2\,H_2O,$$

which, on boiling with zinc dust, is converted into hydrazobenzene, $C_6H_5HN=NHC_6H_5$. By treating with strong hydrochloric acid this body undergoes a molecular change, and is converted into benzidine—

$$\begin{matrix} C_6H_5NH \\ | \\ C_6H_5NH \end{matrix} = \begin{matrix} C_6H_4NH_2 \\ | \\ C_6H_4NH_2 \end{matrix}$$

Benzidine chloride $\begin{matrix} C_6H_4NH_2\,HCl. \\ | \\ C_6H_4NH_2\,HCl. \end{matrix}$

is diazotised by treating with sodium nitrite, and is converted into tetrazodiphenyl chloride, which, when combined with various phenols, amines, &c., form the aforesaid colouring matters. By first sulphonating paranitrotoluene, and then treating the body thus produced with zinc dust and caustic soda, it is converted into diamido-stillbene-disulphonic acid

$$\begin{matrix} CH-C_6H_2\langle^{SO_3H}_{NH_2} \\ \| \\ CH-C_6H_2\langle^{NH_2}_{SO_3H}, \end{matrix}$$

which is diazotised by strong hydrochloric acid into—

$$\begin{matrix} CH-C_6H_2\langle^{SO_2H}_{N=N-} \\ \| \\ CH-C_6H_2\langle^{N=N-}_{SO_3H}, \end{matrix}$$

which, as will be seen, is capable of combination with aromatic amines, &c., to form colouring matters. *Congo red* may be formed by the action of alpha naphthylamine sodium sulphonate on tetrazodiphenyl chloride, and it is by processes analogous to this that all the other colours in this class are formed. The benzidine colours as a class are very sensitive to acids and alkalies, and Congo red is used in volumetric analysis to detect the presence of free acid in such salts as copper sulphate, copperas, alum, &c., which turn blue litmus red, and which when pure do not affect Congo red. Some of the yellow colours, notably chrysamine and chrysophenine, are exceedingly fast to light and soaping. Curcumin, the latest yellow introduced, has very largely displaced turmeric, which has hitherto been very extensively used in Yorkshire. The application of these colours is very simple. They may be dyed at a boiling heat with the addition of common salt. *Primuline*, lately introduced by Messrs. Brooke-Simpson and Spiller, has the composition shown in the formula—

$$S\langle^{C_6H_3\{^{NH_2-}_{CH_3}}_{C_6H_3\{^{CH_3}_{NH_2-}}$$

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It dyes a beautiful yellow on cotton, which may be azotised on the cloth and afterwards "developed" into other colours by passing into solutions of phenols and amines. The red produced by this method equals alizarin in fastness. An interesting discussion followed in which the Chairman, and Messrs. Sieber, Teanby, and Hastings took part.

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CHESTER SOCIETY OF NATURAL SCIENCE.—At a general meeting of the different sections of the above society, held at the Grosvenor Museum on March 28th, a paper was read by Mr. John J. Webster, M.Inst.C.E., of Liverpool, upon "Improvement of Tidal Estuaries," Geo. Dutton, Esq., Mayor, occupying the chair. The speaker first dealt with the geographical and geological condition of the different estuaries, explaining the probable cause of the various formations, and then described the nature of the different obstructions at the embouchure of the great rivers, in the form of banks, bars, and deltas. The action of the wind, tide, and local currents upon the sandbanks and bars was explained, showing that in considering any proposed works of improvement these forces had to be specially dealt with; and it was pointed out that engineers often made the mistake of dealing directly with an actual obstruction, instead of studying how to operate upon the causes. The different methods of dealing with the various obstructions were then described and illustrated by wall diagrams of the works carried out on the Tyne, Clyde, Tees, Mississippi, Seine, Carlingford Lough, Dublin Harbour, Belfast Harbour, &c. He then explained the effect of the above works, and how it was necessary that special work should be designed for any particular estuary, and that what may have been successful in one instance might result in failure in another. He then described fully the different work which had been carried out in the river Dee, from the early proposals of Andrew Yarranton down to the present time, and concluded his paper by a general summary of his remarks and observations.

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LIVERPOOL ENGINEERING SOCIETY.—At the monthly meeting, held on 6th March, Mr. C. S. Pain, C.E., showed a number of lantern slides of the Vyrnwy Waterworks, which included a map of the line of pipes, views of the Vyrnwy Valley, the great dam, &c. Discussions were afterwards raised upon the following subjects:—"The Relative Advantages of Steel and Iron for Engine Shafts," by Mr. T. L. Miller, C.E.; "Is there any 'Fibre' or 'Grain' in Iron?" by Professor H. S. Hele Shaw, C.E.; and "The Cause of Increased Tenacity when the Limit of Elasticity is Exceeded in Ductile Materials," by Professor H. S. Hele Shaw. In dealing with his first subject, Professor Hele Shaw quoted various authorities which assumed the existence of fibre in iron, and proceeded to show that such fibre existed both by exhibiting specimens and by photographs of sections of wrought iron which had been acted upon by acid. He then went on to discuss the question as to what was the nature of such fibre, and proved that it must be due to the existence of minute particles of slag in the original bloom, which, being rolled out into bars and sheets, extended the liquid slag. Votes of thanks were accorded to the readers of the papers at the close of the meeting.

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LIVERPOOL UNIVERSITY COLLEGE, ENGINEERING STUDENTS.—A large number of the members of the engineering students of University College visited, on 6th March, the Liverpool Hydraulic Power Company's pumping station, Athol Street. The students, who in the absence of Professor H. Shaw were accompanied by Mr. T. L. Miller, were received at the works on behalf of Messrs. Ellington and Woodall, the company's chief engineers, by the resident engineer, Mr. Frederick M. Evanson. That gentleman conducted them through the large and commodious station, explaining in detail the process by which the water, taken from the adjoining canal, is forced into the hydraulic street mains at the enormous pressure of 750lbs. to the square inch. Mr. Evanson also pointed out the many points of technical interest in the machinery used. He stated that the Hydraulic Power Company had now laid down in Liverpool between eleven and twelve miles of mains, from which power was supplied to a great number of machines used as warehouse hoists, presses, and passenger lifts. Unfortunately, it seems that so far the application of the company to lay down mains in Dale Street and Castle Street has been refused by the Health Committee, notwithstanding that it has had the support of four of the most important insurance companies in the city. As the high-pressure system is far more economical than any other, it has been pointed out that refusal means compelling these companies to have low-pressure lifts worked at great sacrifice from the Corporation mains. A lift near the Exchange recently worked at low pressure used each full journey 101 gallons of good water. By the high-pressure system the consumption was reduced to 5¾ gallons, and the loss of water in a quarter from 1,370,065 to 78,000 gallons. At the same time the cost of working was less than half of what it was previously.

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GEOLOGICAL SOCIETY OF LONDON.—At a meeting of this society, held on February 20th, papers were read by Mr. S. S. Buckman, F.G.S., on the "Cotteswold, Midford, and Yeovil Sands, and the Division Between the Lias and Oolite," in which were described a series of sections commencing near Stroud and terminating on the Dorset coast. The suggestion was made that the term used by d'Orbigny, "Toarcien," should be employed to designate the strata from the *Falcifer*-zone to the *Concavus*-zone, which should mark an entirely distinct transition formation, separating the Lias from the mass of thoroughly Oolitic strata. "On some Nodular Felstones of the Lleyn Peninsula," by Miss Catherine A. Raisin, B.Sc. This paper dealt with two small masses of rock forming the headlands of Pen-y-Chain and Careg-y-defaid, near Pwllheli, consisting of old lava-flows, now devitrified, associated with interbedded ashy strata. Some of the nodules were considered to result from spheroidal fracture, others to be masses of flow-brecciation, but the majority had a spherulitic crust, often surrounding an interior occupied by secondary quartz or chalcedony. The annual general meeting of the society was held on 15th February. The following presentations were made:—The Wollaston gold medal to Professor T. G. Bonney; the Murchison medal to Professor James Geikie; the Lyell medal to Professor Boyd Dawkins; the Bigsby medal to Mr. J. J. Harris Teale; the balance of the Wollaston fund to Mr. A. Smith Woodward; the balance of the Murchison fund to Mr. Grenville A. J. Cole; and the balance of the Lyell fund to M. Louis Dollo, of Belgium. The president, Dr. W. T. Blandford, then read his anniversary address, which dealt largely with the work of the International Geological Congress from its commencement to the last meeting in London in 1888.——At the meeting held on March 6th the following communications were read:—"On the Subdivisions of the Speeton Clay," by G. W. Lamplugh, F.G.S., in which the author gave the results of a long series of observations made during favourable opportunities at the cliff foot and on the beach at Speeton from 1880 to 1889. It was shown that there is probably a continuous series of clays from the Jurassic to the Upper Cretaceous, and that the deposition of these beds appears to have gone on contemporaneously with the erosion of the beds inland. "Notes on the Geology of Madagascar," by the Rev. R. Baron. The central highlands of Madagascar were shown to consist of gneiss and other crystalline rocks. The volcanic rocks are also of much interest. Sedimentary rocks occur mainly on the western and southern sides of the island. The relations of these have not been fully determined, but the following formations are represented:—Eocene, cretaceous, neocomian, lower oolites, lias, and possibly the silurian or cambrian. The separation of the island was assumed to date from early Pliocene times, if not earlier. Dr. F. H. Hatch also contributed some notes on the petrological characters of the rocks collected at Madagascar by the Rev. R. Baron.

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GEOLOGICAL SOCIETY OF GLASGOW.—At the sixth meeting of the thirty-first session of the Geological Society of Glasgow, held on Thursday evening, 14th March, Mr. Joseph Somerville, vice-president, in the chair, the Duke of Argyll was elected an honorary member, and Messrs. Robert Black and George W. M'Creath ordinary members. The recent death of Mr. Matthew Blair, of Paisley, long one of the society's members, and for some time a member of the council, was feelingly referred to by Mr. John Young, F.G.S. Mr. Blair had read a paper "On the Surface Geology of Paisley" before the society so lately as the January meeting, and within a few weeks afterwards had been seized with his sudden and fatal illness. As one of the enthusiasts in local geology, Mr. Blair will be much missed by the members of this society and of the Paisley Philosophical Society, of which he was at the time of his death one of the vice-presidents. Mr. Robert Kidston, F.G.S., of Stirling, the well-known specialist on fossil botany, read a paper on "The Fructification and Internal Structure of Carboniferous Ferns in their Relation to those of Existing Genera, with Special Reference to British Palæozoic Species." He remarked that up to the present time comparatively little had been done in this field, and that the details which existed were scattered through books and publications almost inaccessible to the student. He therefore proposed to focus and systematise the present state of knowledge on the subject, so that there might be a trustworthy guide to those who might feel attracted to pursue this interesting branch of study. The paper was illustrated by a very large series of drawings and photographs, thrown on a screen by a lime-light lantern. At its close remarks were made by the chairman, by Mr. John Young, F.G.S., and by Mr. Thomas King, who proposed a vote of thanks to the lecturer for his able paper and splendid series of illustrations. Mr. Kidston was afterwards proposed as a corresponding member of the society.

LIVERPOOL GEOLOGICAL SOCIETY.—At the meeting of this society, on Tuesday, March 12th, at the Royal Institution, Colquitt Street, the president, H. C. Beasley, Esq., in the chair, an interesting paper was read by Mr. T. Mellard Reade, C.E., F.G.S., on "Slickensides and Normal Faults." The author described the usual appearance and character of the slickenside surfaces which occur so commonly in the Keuper sandstones and softer sandstone beds of the Bunter series in the district about Liverpool, the highly-glazed porcellanous surface, the striations (which in the vertical slickensides run more or less in the direction of the hade of the fault), and the bleaching of the rock in the neighbourhood of the fault. In few cases is it possible to determine the extent of the movement, but in one case (described in the preceding number of the *Proceedings* of the society, by Mr. Beasley) the rubbings left by a number of clay nodules sheared by the fault, showed that a movement to the extent of six inches was sufficient to produce a fairly well slickensided surface. Mr. Reade also described slickensides occurring in various other kinds of rock, exhibiting specimens collected in many localities. He then described some experiments he had made by rubbing together prepared pieces of stone (in one case fine quartzose carboniferous sandstone, in another of Irish block marble) under considerable pressure, giving as a result smoothed and striated surfaces, together with a quantity of fine floury powder produced by the attrition. This powder in some cases caked together, and the author suggested that the action of water containing carbonic acid in solution would gradually dissolve the powder and re-deposit it in the interstices between the grains of the rock. This deposit is seen in the case of the secondary quartz crystals, which give rise to the sparkling appearance of the quartzose pebbles occurring in the Bunter sandstones. And, in the case of these faults, the effect would be to give rise to a porcellanous or crystalline surface such as is actually met with; and this is confirmed by the fact that, in the case of some of the porcellanous sandstone faces examined with a hand lens, shows grains of polished rock in the matrix more susceptible to weathering. (The author exhibited microscopic slides showing a similar character). The conclusion to which he had been led as to the origin of slickensides was that they were produced by the attrition of two rock surfaces under great pressure, and afterwards slowly modified by the circulation of water. Mr. Reade's discussion of normal faults was for the most part considered in connection with his theory of mountain building, as recently explained by him in his work on the "Origin of Mountain Ranges," and in his articles in *Research*. He contended that normal faulting must be considered in connection with the folding and lateral pressure which the earth's crust has undergone, and that the explanation of one phenomenon must not be inconsistent with the explanation of the other. In folded strata, where faults occur, the faults interrupt the continuity of the strata, and therefore the origin of faults is posterior to the folding, and both are not due to the same cause. The contraction theory of the formation of mountain ranges is inconsistent with the existence of normal faults. According to his theory, rise of temperature in any portion of the crust (induced by sedimentation) is followed by increased volume, which necessarily takes place for the most part in a vertical direction. On the other hand, lowering of temperature is accompanied by a decrease of volume, and as this takes place not on the surface layers (which are constant at the mean temperature of the locality) but in the deeper portion of the crust, the former would be left without support, but that they shear into wedge-shaped masses, which fall down and serve to "key up" the broken strata. According to this theory, then, any rise of temperature in strata gives rise to upheaval, lateral compression, and folding, whilst a fall in temperature is followed by contraction and normal faulting.

LIVERPOOL GEOLOGICAL ASSOCIATION.—At the ordinary meeting of this association on the 4th March, at the Free Library, William Brown Street, the vice-president, Mr. T. R. Connell, in the chair, a paper was read by Mr. W. D. H. Deane, M.A., on "Meteorites." Commenting on the universal presence of dust in the air, and on the metallic nature of a considerable portion of this, the author discussed its probable origin, pointing out that whilst some part of it was due to eruptions from volcanic centres, the remainder must be of cosmic origin, having been showered down from outer space. The various systems of meteorites which annually cross the earth's path were then described, and illustrated with lantern views. An account of the structure of the meteoric masses which occasionally reached the earth from without naturally led to a comparison between these bodies and certain rocks and minerals known to form part of the earth. To the iron and nickel which built up the greater part of certain meteorites had been added a couple of new minerals found sparingly distributed in them, and not hitherto recognised in terrestrial rocks. Certain immense boulders of iron found on the beach in Disco Island, Greenland, formerly thought to be of meteoric origin, were figured on the screen, as also were the cliffs of basaltic lava from which the boulders had almost certainly been derived. A concluding reference to the knives and other implements which the Greenlanders had fashioned out of the iron which was within their reach, with expressed doubts as to the general application of the archæological divisions known as the stone, bronze, and iron, led to an animated discussion, in which Messrs. Gasking, Potter, Clague, and the secretary (Mr. I. E. George) took part.

LIVERPOOL MICROSCOPICAL SOCIETY.—The usual monthly meeting was held on March 1st, at the Royal Institution, the president, Mr. I. C. Thompson, F.L.S., F.R.M.S., &c., in the chair. The paper of the evening was by Mr. J. Lomas, Assoc.N.S.S., on "Some Points of Resemblance Between Slags and Glassy Igneous Rocks." He described in the first place the conditions under which igneous rocks had been formed, and then, dealing more especially with the

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glassy varieties, showed how structures were developed by incipient crystallisation, shrinkage, and motion of the mass when fluid. The researches of Sorby, Vogelsang, and others were referred to, and examples were given where devitrification had taken place subsequently to the solidifying of the rock. In the next place Mr. Lomas described devitrification in artificial glasses, and criticised the views of Messrs. Hermann and Rutley given in a paper before the Royal Society. The shrinkage cracks were considered as being due to crystallisation, rather than crystallisation resulting from cracks being formed. It was shown that a mass must become less on crystallising, for the gravity of a glassy material is lower than that of the same material when crystallised. The structures in various slags, such as Cleveland steel slags, Sheffield Spiegeleisen slag, Northampton blast furnace slag, &c., were described and compared with those of igneous rocks. The resemblances between silicate cotton and Pele's hair were mentioned. The paper was illustrated by lantern transparencies and drawings, as well as numerous specimens and microscopic preparations. At the close a discussion took place, in which the president, Mr. E. Davies, F.I.C., F.C.S., &c., Mr. H. C. Beasley (president of the Liverpool Geological Society), and others took part. The meeting then resolved itself into a *conversazione.*

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Liverpool Amateur Photographic Association.—The new club rooms of the above association, North Crescent Chambers, 3, Lord Street, were opened to the members on February 28th. A crowded meeting testified to the interest felt in the new era in the history of this, the premier Amateur Photographic Society of England. After opportunity had been afforded to examine the elaborately-fitted dark or manipulating room, the beautiful pictures and gems of photographic art contributed by some of the best workers in this country, an ordinary meeting of the society was held, the president (Mr. A. W. Beer) in the chair. In the course of the evening two papers were read by members of the society, illustrated by the lime-light under the management of Mr. P. H. Phillips; the first, by the Rev. T. A. Bartlett, M.A., entitled "Brittany and Normandy;" the second, by Mr. Jos. Earp on "Holland and Belgium with a Detective Camera." An enthusiastic audience voted cordial thanks to these gentlemen for their lectures.

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Royal Society of Edinburgh: Portable Dust-Enumerator.—A paper from Mr. John Aitken, Falkirk, was read at the meeting of the Royal Society of Edinburgh, on the 18th March, on his improvements upon the apparatus for enumerating the dust-particles in the air. He has been able to reduce the principal parts so as to make the whole easily portable—only one tenth of its former size. He has the instrument with him in Paris, making experiments there, but he hopes to be able to show it to the Fellows at their next meeting. Meanwhile he sent the results of some of his observations during the last month. Again he tested the pure air of Colmonell, in the south of Ayrshire, and found that during dull and rainy weather the number of dust-particles in a cubic inch of air was 160,000. The lowest register at that clear-aired place, which showed the air to be particularly free from artificial pollution, was 8,000, and this result was obtained on a bright, dry day. The readings taken near Falkirk, where the air was very highly charged with smoke from the iron smelting furnaces, indicated above two million particles per cubic inch. He then compared the quantity of dust in the atmosphere at Glasgow and Edinburgh. In Glasgow the readings were taken at a point in the proximity of the Central Station, and the lowest obtained on a fair, clear day, when a strong north-westerly gale was blowing, showed the number of dust-particles per cubic inch to be 2,800,000; while the highest, when the weather was wet and stormy, showed that there were 7,700,000 dust-particles in a cubic inch of air. He considered the lowest register there to indicate the atmosphere quite as free from dust-particles as it was ever likely to be in that city. In Edinburgh the lowest result obtained showed the dust-particles to be 750,000 per cubic inch, and this on a fair, clear day. On a fair, though dull and thick day shortly afterwards, the apparatus registered 4,100,000 per cubic inch. Other observations had been made—with regard to the purity of the atmosphere resting on the sea in this instance—at Ballantrae, and the result went to show that on the second visit the apparatus registered in the cubic inch 83,000 particles. The observation was made on a fair, bright day, when there were no artificial impurities in the atmosphere. This fact led Mr. Aitken to ascribe the existence of the particles to the action of the small waves near the shore, which charged the air with a large number of brine-particles. As dust-particles are necessary for the formation of fogs, the prevalence of the brine-particles in the air over the ocean occasions more dense fogs at certain seasons than could otherwise be accounted for. The brine-particles there act like the sulphur-particles in towns, to occasion more than the average quantity of fogs.

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Teachers' Guild, Manchester: Manual Training in Schools.—The meeting held on February 25th, Mr. T. C. Horsfall in the chair, was devoted to the subject of manual training in schools. Mr. J. H. Reynolds, of the Manchester Training School, read the first paper, which dealt with the place of manual training in education, and said that we were only just beginning to adapt ourselves to that intimate and actual knowledge of things which Pestulozzi, Froebell, Spencer, and others had so assiduously advocated. Object teaching was the very foundation of the manual school, and the Kindergarten was the road which led directly to it. Kindergarten teaching and the manual school were one and the same, identical in aim, but adapted to different periods in school life. Our present system of education restricted its range to the expression of speech and writing, and had regard only to the professional and mercantile sides of life. But it must be remembered that we were not only a mercantile nation but a manufacturing nation, and our supremacy—nay, our very existence—depended on our power to preserve our position as the workshop of the world. Neither were we only a manufacturing nation but we were a colonising nation. Our population was increasing at the rate of nearly 1,000 per day, and we could no ignore the fact that the great proportion of these would sooner or later find their way to distant lands, there to carve out for themselves a career dependent entirely upon the skill and energy of their hands. As it was, scores of thousands left these shores every year with no manual skill or industrial experience of any kind only to add to the congestion which already existed in the United States and the great towns of our colonies. The recognition that manual training must form an integral part of every child's education was gradually dawning upon us, but in this matter we were only following the wake, and that a long way behind, of Germany, Sweden, Finland, and America, where manual training in all its varied forms was accepted and recognised as necessary to the full moral and intellectual culture and development of child nature. Miss M. Ward, of the Ipswich High School, contributed a paper, which was read by Miss E. Wilson, in which she described the Sloyd system of training generally, and the Naas system in particular. Miss Ward has gone through a course of training at Naas, in Sweden. She explained the word Sloyd to be an adjective of Swedish origin, not to be found in any other Scandinavian tongue, which signifies capable and skilful. This training, which is chiefly in woodwork, is intended to make its pupils skilful in hand at an early stage, and not in any sense to supersede the apprenticeship to any special trade. Miss Ward maintained that the Sloyd system engendered neatness, habits of order, cleanliness, and exactness, and without disparaging sewing for girls she held that Sloyd teaching was essentially hygienic and much preferable to sewing, and was found to be exceedingly

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interesting by its students. Mr. J. S. Thornton, B.A., described the study of Sloyd at Naas. Mr. Thornton, as a specimen of the work, showed how a spoon was made by the children. He has fitted up a small room for Sloyd work in his own school, which is in successful working. He is a member of the Sloyd Union, and expressed himself most willing to give any information.

Reviews.

THE *Institute* is the title of a monthly publication designed to be specially useful to lecturers and others. It contains reports of lectures on scientific and general subjects delivered at various parts of the kingdom. Such a guide should be valuable to societies in arranging for their lectures and public meetings.

The Forts of Erin, from the Firbolg to the Norman, is a small pamphlet by Mr. S. F. Milligan, M.R.I.A., which gives, in a lucid and particularly interesting manner, the result of the labours of the ethnologist and the historian in dealing with the remains of a primitive architecture in Ireland.

"Mann" or "Man" is a reprint of the report of the discussion which took place at a recent meeting of the Isle of "Mann" Natural History and Antiquarian Society, on the vexed question of the orthography of the name of the island. Dr. Haviland's argument in favour of the more usual and modern spelling with one "n" did not lead to the adoption of the alteration in the society's title.

Lessons in Elementary Mechanics. Stages 2 and 3. By W. H. Grieve, P.S.A.
[London: Longmans, Green & Co.]

THE author of these two introductory works on Mechanics is one of the Science Demonstrators to the London School Board, and has succeeded in constructing clear and accurate text-books for school use. They are specially adapted to the requirements of the New Code. In the second stage the author treats of matter in motion; the weight of a body, its inertia and momentum; measures of force, work, and energy, and heat as a form of energy. The third stage includes the simple mechanical powers, lever, wheel, and axle, pulleys, inclined plane, wedge and screw; liquid pressure; the parallelogram of velocities; and the parallelogram of forces. The text is rendered more interesting than usual in books of this character by the homeliness and familiarity of the explanatory examples employed, whilst the numerous illustrations scattered through the pages add much to the value of these lessons. The chapter on the "Forces of Nature" is very clear and succinct, and the author's explanations are usually sufficiently lucid as to be understood by every student without difficulty.

Free Public Libraries. By Thomas Greenwood, F.R.G.S.
[London: Simpkin, Marshall & Co. 6th thousand.]

WE reviewed in a recent number the same author's "Museums and Art Galleries." Both of the works (of which that now under notice is the earlier) have met with remarkable success and have supplied definite wants. The progress which the free library movement has made in all parts of the kingdom is most gratifying. Free libraries are no longer looked upon as luxuries but as necessities of the day. Since the first edition of this handbook the work has been re-written and brought up to date. It now contains the most complete and valuable information on the subject of public libraries, and cannot fail to be serviceable to all who have the intellectual progress of the nation at heart.

Journal of the Liverpool Astronomical Society. Jan., Feb., 1889. Edited by Isaac H. Isaacs.

THESE two parts of this excellent publication fully maintain its high standard of excellence. Amongst the articles of interest which appear are the following:—"When did the Moon Lose her Atmosphere?" and "The Evidences of Submerged Continent Along the Lunar Prime Meridian," by S. E. Peal; "On the Opera Glass for Astronomical Observations," by Major E. E. Markwick; "The Satellites of Mars," by J. E. Gore, F.R.A.S., together with notes of astronomical observations and reports of the society's meetings.

Alternative Elementary Chemistry. By John Mills.
[Sampson Low, Marston & Co.]

THIS is a little book, as Professor Thorpe says in the preface, "designed to aid both the teacher and the pupil to perform and to understand the meaning of the various experiments suggested in the Syllabus of Alternative Elementary Chemistry." It appears to us to carry out its design in a clear and explicit manner. The book is somewhat on the lines of Roscoe's *Primer*, but is fuller and more complete. The experiments are strikingly simple, notably their showing that air has weight, the decomposition of steam by red-hot iron turnings, the preparation of soap, and the distillation of alcohol. At the end is given a list of apparatus necessary, remarkable for its brevity and simplicity, but its cost and the name of some maker who would prepare it might well have been added. Altogether we can recommend the book as one admirably suited for its purpose, and one which, conscientiously and practically worked through by a student, could not fail to put him in possession of the leading facts of the chemistry of common life.

The Journal of Conchology. Jan., 1889. Conducted by John W. Taylor, F.L.S.

THIS number is the first of the sixth volume of this magazine, and contains lists of shells from different localities, both at home and abroad, together with descriptive notes on discoveries of new species, and much other matter of interest to lovers of conchology. Dr. J. W. Williams contributes some "Preliminary Notes on the Phenomena of Muscle-contraction in the Mollusca," in which he separates ciliary-action from muscle-contraction proper. The cilia, he says, do not seem to be under the control of the nervous or circulatory system, and their motion resembles the spontaneous movement of protoplasm.

Obituary.

THE REV. J. G. WOOD, M.A., F.L.S.—We regret to have to chronicle the death of this well-known naturalist, at Coventry, on the 3rd ult., from an attack of peritonitis. He will be remembered as the author of some of the most popular works on natural history extant, and for his excellent "sketch-lectures" on zoology. Born in London in 1827, Mr. Wood entered Merton College, Oxford, in 1844, taking his M.A. degree in 1851. For a few years he occupied a post in connection with the Anatomical Museum at Oxford, where he was a contemporary of Mr. Frank Buckland. He engaged in clerical work, and held, amongst other appointments, the post of assistant chaplain at St. Bartholemew's Hospital, and precentor of the Canterbury Diocesan Choral Union. During 1883-84 he held the appointment of Lowell Lecturer at Boston, Massachusetts. As a popular expositor of the facts of zoology Mr. Wood had no living equal. His chief works were "Common Objects of the Sea Shore," "Homes without Hands," "Insects at Home," and a large "Natural History" in three volumes, besides which he was a constant contributor to current magazine literature. A special feature of his lectures was the facility with which he drew on a canvas, in coloured chalks, representations of the denizens of "pond and stream," and of the other living creatures he had so long and carefully studied. His explanations were always simple and clear, and by his work he induced in great numbers of persons a liking for natural history observations which they would, perhaps, have never otherwise obtained. His remains were interred at Radford, a quiet little hamlet situate a short distance from the town of Coventry.

THE REV. W. ALLPORT LEIGHTON, B.A., F.L.S.—We have also to record the death of this distinguished botanist and antiquary at the age of 84. Mr. Leighton was a standard authority on the botany of Shropshire, and his archæological contributions are extensively known. He edited the *Transactions* of the Shropshire Archæological Society for nearly ten years, during which period he made an elaborate series of examinations and transcriptions of parish registers and records of great value to local students.

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HENRY ECROYD SMITH.—The death is announced of this well-known antiquary at Middleham, Yorkshire, at the age of 66. Mr. Ecroyd Smith was for many years connected with the Mayer Museum of Antiquities at Liverpool, and was the author of a large number of papers bearing upon the Natural History and Archæology of the Mersey District. His most important work is entitled *Reliquæ Isurianæ*: the remains of a Roman Isurium, Aldboro', Yorkshire. A summary of his contributions to the *Transactions* of the Lancashire and Cheshire Historic Society has been compiled by Mr. Thomas Formby, of the Free Library, Liverpool, and has appeared in the *Manchester City News*.

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Letters to the Editor.

Notice to Correspondents.

It is important that Letters to the Editor should be as brief as possible and to the point, as it is difficult to find space for lengthy communications. Several letters received have been quite too long to be published in full, and we regret that we cannot find room for them in this number.

"A SCOTCH VOLCANO."

["OLD GEOLOGIST" sends us a long criticism on the above article, which appeared in our February number. We regret our inability to afford space for such lengthened comments on articles appearing in our columns as those which our correspondent sends us; but, in order that his views may receive attention, we append an abstract of the chief points of his letter.]

One or two points, says our correspondent, suggest themselves on perusal of Mr. Lomas's clearly-written article. In regard to our knowledge of the origin and internal structure of volcanoes, the question is raised:—"What light is there that we can gather from extinct examples, worn and rendered into wrecks though they may be, which we may not receive from our present active, or recently active, examples?" At once, we may as well concede, that it is in natural sections alone we really perceive the true character, and the exact relations of the parts, of the internal structure. Here we see how vast intrusive sheets may fissure through the lava streams and surrounding rocks, and how long flows of dykes may run from hence far and wide. What to-day is the open, weathering surface, was long ago hidden, far down, as a deeply-buried secret. From which, it is self-evident, that in these basal wrecks, and under such conditions, we must gather insight that otherwise we might not obtain.

But there is another point not quite so obvious. What, it may be asked, can be learned from our ancient and extinct volcanoes which will throw light upon their origin? They are found widely scattered and in many lands. Surely, with so many instances for observation, the origin of volcanic eruption ought to be a fairly easy question, or one, at least, very largely understood, if these greatly-denuded cones afford so much light and knowledge. Yet what are the facts? How much exact knowledge as to the cause of volcanoes do we possess? Why, to-day, in sober fact, confession is still ours that our explanations are as much as ever mere hypotheses, even though they be more nicely balanced and more adroitly arranged. And so far as these theories are concerned, approximately correct as they may seem to our present condition of information, they certainly do not receive their *imprimatur* from the basal wrecks of Mull, or of anywhere else. In a brief concluding paragraph Mr. Lomas lightly mentions, and as easily dismisses, Dr. A. Geikie. This is following a final reference to Professor Judd, to whose works he confesses his obligations, and who is the authority in conflict with Dr. A. Geikie. The wording of this paragraph is rather unfortunate, as, while the reference to the new work of the Director-General of Geological Survey is quite correct, at the same time it is misleading. The opinion of Dr. Geikie is not one arrived at yesterday and just expressed; it is a well-known one, and has been before the world a number of years. Now, while it may be perfectly permissible for Professor Judd or Dr. Geikie to speak in terms of more or less striking dogmatism, I must dissent from the view that licence is therefore given to whomsoever will to go and do likewise. Dogmatism is only justifiable when controversy has settled into ultimate and general consensus of opinion, and where the fullest and amplest investigation at our command has been exhausted. At present, Mull has not as yet been geologically surveyed. To mention Dr. Geikie, therefore, and dismiss his view almost in a single line, is hardly just to one of the great classic writers of the age, any more than it can be said to be fair to the readers of *Research*, who, from the perusal of Mr. Lomas's article, would presume that the geology of Mull was a settled matter.

Referring to the statement of Mr. Lomas, that "the basic lavas are never penetrated by acid varieties," Dr. Geikie says there are many examples of such. Again: Mr. Lomas speaks of successive rings encircling a central mass of gabbro and coarse dolerite. Around this centre he puts granite, &c., followed by a further ring of agglomerates, which in its turn is surrounded by "a well-defined ring of acid lavas, felstones, &c." This, even according to Professor Judd, is not exact, for the agglomerates are not described by this author as having a ring of felstones outside of them. The limits of the agglomerates mark also the limits of the felstones. But the statement is still more questionable when it is remembered that the island has not as yet been worked out with that carefulness and minuteness which is a *sine qua non* before the geology of a district should be definitely declared.

As to the brief summary of his facts in his final paragraph, continues our correspondent, I may remark that were these beyond dispute they might, or might not, be held to prove his case. I certainly do not say that ultimately it will be shown that he is wrong in following Professor Judd. Only I do urge this, that as these facts are by no means admitted to be correct, and doubt still clashes amongst them, the statement that in the face of them "no one can fail to see evidence of true volcanic phenomena," is a hasty generalisation. Of these points, the concentric arrangement of the rocks is by no means admitted and quite problematical; the sum of the evidence of the radiating dykes is confessedly of a negative character, while the existence of *puys* proves nothing on either side, as Dr. Geikie points out, and emphasises that along the great line of weakness eruptions took place at a number of points, some of which were large and some of which were small. It will thus be seen that the matter is by no means so simple, and quite possibly when Mr. Lomas has read—which from his paper I fancy he has not—the new work on the "History of Volcanic Activity During the Tertiary Period in the British Isles," he will find cause to moderate his opinion.

[*Note by the Author of the Article.*—In the first place it will be necessary to state that I do not hold a brief to defend Professor Judd or anyone else. The article was intended to place before the readers of *Research* a short account of the observations made during a recent visit to Mull. These were made after a careful study of the literature published on the subject, and if my conclusions agree in the main with those expressed by Professor Judd I cannot help it. "Old Geologist" accuses me of not having read Dr. Geikie's new work on the "History of Volcanic Activity During the Tertiary Period in the British Isles," a paper read before the Royal Society of Edinburgh. The work was not issued when my paper was written. I had, however, the main points of Dr. Geikie's article before me, having obtained them from private sources and the press notices which had appeared. The criticism of "Old Geologist" begins with some observations on the relative values of active and extinct volcanoes as objects of study. The remarks are so obscured behind a cloud of fine phrases that I must be forgiven if my limited vision fails to see whether he approves or objects to my views. It is interesting to note that "Old Geologist" has graciously licensed Professor Judd and Dr. Geikie to dogmatise, but I am afraid these eminent geologists will hardly appreciate the honour. It would be trespassing too much on your valuable space to refute every point raised by "Old Geologist," nor is it at all necessary, for they are in the main mere quibbles and personal reflections, and as such are best left alone. In conclusion, let me say that I shall be amply rewarded for my pains in writing the article if "Old Geologist" is induced to visit Mull, and ascertain for himself whether the ideas therein put forth are true or not.—J. LOMAS.]

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DEATH OF THE YOUNG GORILLA FIGURED IN "RESEARCH" FOR MARCH, 1889, *p.* 143.

SIR,—I regret very much to state that in a letter received by Mr. R. W. Roulston from Mr. J. J. Jones, dated Ngove, January 8th, 1889, the death is announced of the above specimen, after one day's sickness only, under circumstances suggestive of possible ill-treatment. Mr. Jones is now in possession of a young male gorilla, a fine example, but not comparable with "poor little Jennie."

Free Public Museum,
Liverpool, March 26th, 1889.

THOS. J. MOORE.

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Publications Received.

Report of Smithsonian Institution, Washington, 1885, parts 1 and 2; *Journals John Hopkins' University, Baltimore; Museums and Art Galleries*, Thos. Greenwood, and *Free Public Libraries*, T. Greenwood (Simpkin, Marshall & Co.); *The Standard of Value*, Wm. Leighton Jordan (Longmans and Co.); *Sound, Light, and Heat*, M. R. Wright; *Theoretical Mechanics*, J. Edward Taylor, and *Mathematics* (Longmans' Elementary Science Manuals); *Tales of Science*, Dr. J. G. McPherson (James Gemmell, Edinburgh); *Life Lore; Vannin Lioar*, No. 1; *The Naturalist* for January, February, and March; *Monthly Circular* of the Huddersfield Naturalists' Society; Nottingham Naturalists' Society *Annual Report and Transactions; Transactions* of the Leeds Geological Association; *The Brewer's Journal; New Commercial Plants and Drugs* (Christy & Co., London), &c.

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NOTICES.

☞ *As some complaints have reached us as to difficulty and delay in obtaining "Research," we specially ask that when difficulty is experienced communication may be at once made to one of the Publishers named below, or to Mr. E. O. Windel, 9, Hackin's Hey, Liverpool.*

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of news and important additions to their colle ctions.

Communications intended for insertion in the followlng numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Scientific Field Work.

MANY scientific societies are now preparing for, or have already commenced, their excursions for field work. The value of such work, in which scientific students are brought face to face with nature, cannot well be over-rated. Opportunities for study are thus afforded which it is impossible to find in the class-room or lecture theatre, or during the ordinary meetings of the winter session.

But are these opportunities made full use of? We are afraid not. Too frequently the excursions are scientific only in name, and take the form of pleasant "outings" in the country, without much real work being done.

To make field work really useful for scientific study it is essential that it should be thoroughly systematised. There should be some definite object in view in arranging each excursion, and each member of the party should be fully informed, by a well-arranged printed programme or otherwise, what are the several features of the day's work, and in what way that work can best be carried out.

The leaders should be well versed in the subjects to be studied, and capable of giving information to those who need it. The practice now adopted by many societies of appointing referees for special branches could be made very useful in field work, as such referees could act as leaders on occasions when their specialities are being studied, and they can in other ways direct the operations.

The practice of making careful notes should be insisted on, and opportunity should be afforded for comparing notes and discussing the results of each excursion. This may be done either during the excursion, by leaving sufficient time after active search work has ceased, or by holding special indoor meetings on a subsequent day. This latter course is, we know, adopted by some societies with excellent results.

Careful reports, giving detailed results of each meeting, should be drawn up for present information and future reference, and every effort should be made to follow up and thoroughly study any new features that may be brought to light. In preparing reports correct drawings would often be found very serviceable, or resource may be had to photography. This would be especially serviceable where, as is often the case in geological and other matters, the objects noted may after a time be removed or otherwise disappear.

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It would be well for each society to carefully map out its own district and study each part of it in a systematic manner, investigating one part after the other in some definite relative order. A good map of the district should also be obtained or prepared, and the position of each new "find" marked on it. It is also desirable that societies from different districts should occasionally visit each other and compare notes, and societies studying different branches of science may frequently find it advantageous to join together in field work, especially when the sciences have some close relation to each other; for example, entomologists could discuss with botanists many points having relation to insect and plant life, and geologists and chemists could often find much to study in common with advantage. This interchange of views between members of different societies could not fail to help forward scientific studies in very great degree.

The federation of kindred societies, to which we briefly alluded in our fifth issue, would aid much in making field work of valuable service in science studies.

In noting the out door work of many societies it seems to us that it can be made more complete. As an illustration we would mention that the work of some Field Naturalists' and Botanical societies run more especially in the direction of the department of systematic botany, the chief work of each meeting being determined by the offer of prizes for plants belonging to one or more special orders; but with the whole phenomena of plant life to study, and the excellent opportunities for doing this that field work offers, and with the many examples of splendid results accruing from the study of physiological processes and other departments of plant life, surely the programme of work should sometimes depart from the old beaten track.

We strongly urge upon those who direct outdoor studies to well consider every possible means of creating interest in good, steady work, and then show how it is to be done on each separate occasion. In this way the members of societies will gain sound information and credit for themselves and, at the same time, add largely to our knowledge of the world in which we live.

The Carboniferous Limestone near Llangollen.

By G. H. Morton, F.G.S.

THE recent visit of the Geological Congress to Llangollen has directed attention to the Carboniferous Limestone, which is well developed in North Wales, and reposes on the Silurian and Cambrian rocks. At the time of its formation it must have extended in a great continuous deposit to what are now known as Derbyshire, Yorkshire, North Lancashire, the Isle of Man, and Ireland. It originally extended over more of North Wales than it does now, though most of the high land between the Vale of Clwyd and the Menai Strait was above the sea during the time it was deposited. The limestone forms a prominent belt of country from the north to the south of Flintshire, dips beneath the coal-measures, and, no doubt, continues under the superior strata until thrown up and exposed on the surface far to the north-east over the counties referred to.

The Carboniferous Limestone of North Wales is remarkable for the prominent high ground it presents from Llanymynech to Prestatyn, from Llanelidan to Ruthin, Denbigh, Abergele, and Great Orme's Head, across Anglesey, and fringing both sides of the Menai Strait. The limestone forms about twenty-two detached areas, which vary considerably in extent, that containing Llandegla, Mold, and Holywell being the largest, and twenty miles from north to south, with a breadth varying from two to four miles; while there are several small areas, such as Hafod, near Corwen, Bodfari, Llanbedr, and others in the Vale of Clwyd only a few acres in extent.

The Carboniferous Limestone may be examined, and fossils collected, over any of these areas, but the grandest and most accessible exposure in North Wales occurs near Llangollen. The precipitous and lofty ridge known as Creigiau Eglwysegle, or the Eglwyseg rocks, presents the whole of the limestone in an unbroken series, from the red sandstone at its base to the Cefn-y-fedw Sandstone, which represents the Yoredale or Millstone grit at the summit. Every bed of limestone is exposed, so that the lithological characters of the strata, and the fossils they contain, may be easily examined. The finest views of this magnificent section are from the top of Castell Dinas Bran, 1,052ft. above the sea, and from the Tynant Ravine, rather over a mile further north. In my papers on "The Carboniferous Limestone and Cefn-y-fedw Sandstone of North Wales," * the subdivisions into which the limestone is naturally divided are given as follows:—

Upper grey limestone	300ft.
,, white ,, ...	300ft.
Lower ,, ,, ...	120ft.
,, brown ,, ...	480ft.
	1,200ft.

Each of these subdivisions may be distinguished from the summit of Castell Dinas Bran, and may be more minutely examined in the Tynant Ravine. The photograph represents the limestone cliffs on the north side of the ravine, and the sub-divisions are indicated by birds flying over them. Just a little north of the ravine, on the right of an ascending path, specimens of the shell *Productus Llangollensis* and the supposed radiolarian *Calcisphæra* sp. are abundant in the Lower Brown Limestone, and may be easily obtained.

On reaching the high ground at the top of the ravine, the outcrop of the highest beds of the Upper Grey Limestone occurs along a low ridge of broken limestone, and fossil corals of several species are so abundant as to suggest the occurrence of a coral reef when the rock was formed. The following species are most common:—*Clisiophyllum turbinatum*, *Cyathophyllum regium*, *Lithostrotion junceum*, *L. irregulare*, and *Lonsdalia rugosa*. The geologist should follow the outcrop of the beds towards the south-east, where several small openings will be seen, and both shells and corals may be collected, for they are abundant. Of the former, the following are of most frequent occurrence:—*Spirifera bisu cata*, *S. crassa*, *Productus giganteus*, and *P. latissimus*.

The highest ground, a few hundred yards to the north, is composed of the Cefn-y-fedw Sandstone, so named from the hill itself. The strata are exposed in many places, and consist of sandstones and shales. The lowest beds are of white sandstone containing numerous quartz pebbles, but there are no fossils. From the fossiliferous beds of the Upper Grey Limestone it is easy to find a path down to the Lower White Limestone quarries, where the following shells occur:—*Euomphalus tabulatus*, *Murchisonia verneuiliana*, *Myacites sulcatus*,

* *Proceedings Liverpool Geological Society*, vols. iii., iv., and v.

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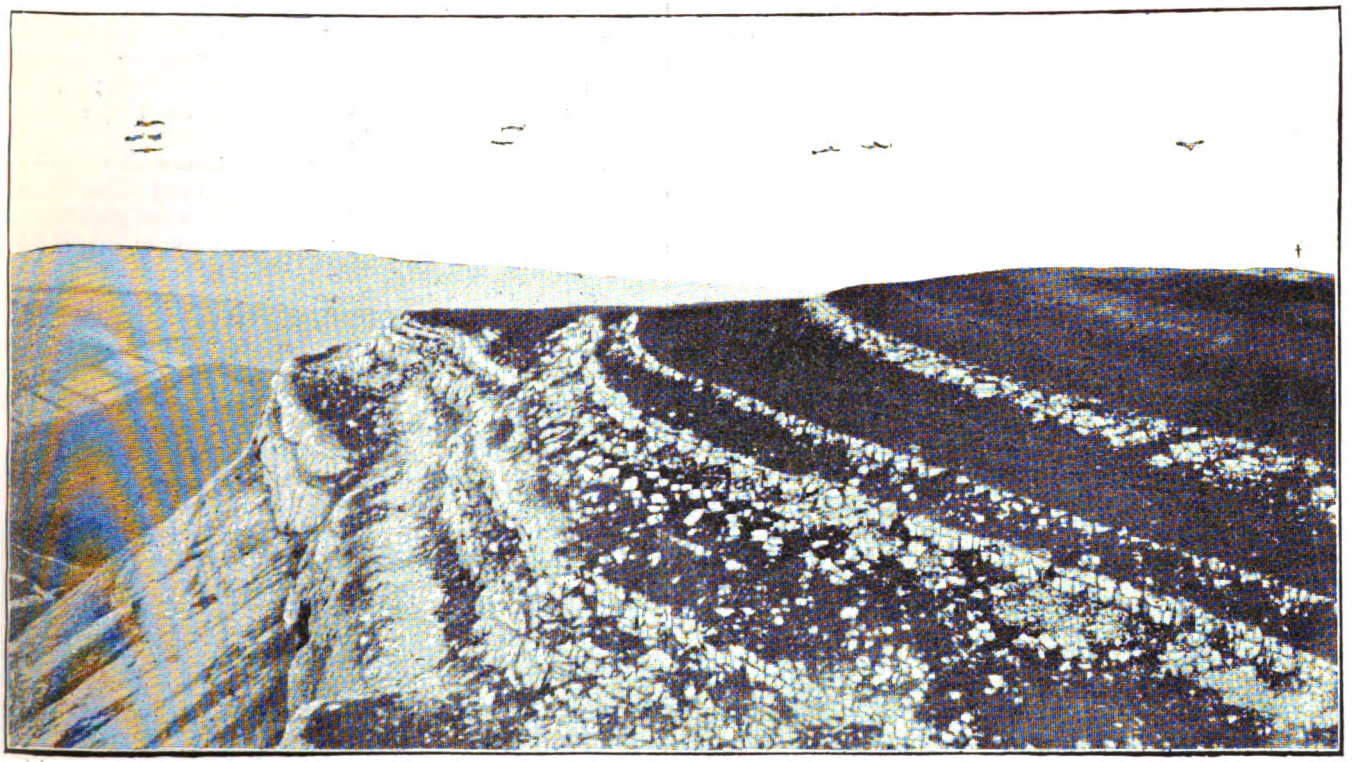
Athyris expansa, *Productus cora*, *P. semireticulatus*, and *Spirifera lineata*. From the quarries Llangollen may be reached along either side of the Dinas Bran.

Although the whole thickness of the Carboniferous Limestone at the Tynant Ravine is 1,200ft., and opposite Castell Dinas Bran 1,025ft., it is only 607ft. at the south-east of the large quarries, and 295ft. at Bronheulog; while at Fron, on the other side of the vale, it is still further reduced to 115ft. in thickness.

This remarkable attenuation is the most interesting feature connected with the Carboniferous Limestone near Llangollen, the cause being that the sea in which it was deposited was much deeper towards the north-west and much shallower towards the south-east, near where the margin of the ancient land must have been situated. The consequence of this varying depth of the sea was that the lower strata were only deposited in the deepest portion, and the upper strata in the more shallow water. It is probable, however, that a gradual subsidence of the area was in progress during the deposition of the strata, and that the subdivisions were each formed in succession, from the lowest to the highest, as the old Silurian land subsided and became covered by the sea.

The absence of mineral veins in the district is very remarkable, but the strike of the strata along the Eglwyseg rocks being nearly the same as the general direction of the veins in the limestone further north probably accounts for none having been discovered. If there are any such veins they must run parallel with the ridge, but the attenuation of the limestone renders it very unlikely that they would be of any importance.

From the very brief description that has been given of the limestone near Llangollen, it will be obvious that it possesses great attraction for the geologist, and other localities where it occurs have all some special features of their own. The late Rev. W. S. Symonds, F.G.S., in his "Records of the Rocks," reminds us that "the Carboniferous Limestone is beloved by the geologist for its picturesque scenery, its caves with their stores of old bones, and the number and variety of its fossils; by the botanist for the rare and beautiful plants nourished in its fissures and on its slopes; by the archæologist for its cromlechs, old camps, and ancient dykes; and by the historian for its memories of many a hard battle, and many a struggle for independence, fought out to the death among its ravines and dingles."



CLIFFS ON THE TOP OF THE TYNANT RAVINE, NEAR LLANGOLLEN.

† *Site of Quarry.* ⌐⌐ *Upper Grey Limestone.*

The (⌐⌐⌐) Upper and (⌄⌄) Lower White Limestone form the Middle White Limestone.

⌄⌄⌄ *Lower Brown Limestone.*

Germicides for Consumption.

BY DR. MCPHERSON, F.R.S.E.

CONSUMPTION, of all the diseases that afflict mankind, is one in which are strangely combined, in extremes, hopelessness and hopefulness; the former in the eyes of beloved friends, the latter in the sufferer's mind. To North Britain's hardy sons of toil it is a dread enemy. There the atmosphere is at times so raw and piercing to the delicate lungs of the less robust of the family that the ravages of the fell disease become inexorable. To the strong the hard, clear air is the source of invigoration for the frame, but to the weak-chested it is the dire assistant of death. The rime and hoar frost are simply killing. There is no escape when the hectic flush is seen upon the waxy cheek, and the blue veins stand cord-like on the pale, thin brow. But how beautiful is the countenance

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of the patient, almost unconscious of death's knock at the portals of life. The bright eye, the delicate face, the sweet lips, the refined, roseate cheeks, have an indescribable charm for us—we cannot tell why. That winning grace and loveliness does not betray the "hall-mark" of death, but too sure is it there. Sad is it to watch the fall of autumn leaves, but far sadder is it to watch the flower of spring faded in its fresh blossoming. And as the end approaches we seem to watch the struggle between the angels of life and death. The eye becomes darkened beneath its tearful lid, the cheeks are desolate of the banner-rose of health, the veins wander on the sunken brow, the hands are transparent, the lips are bloodless and without a smile. Soon the grave sets its sign of death upon the worn-out and wasted frame.

And is there no antidote to the fell poison which carries off its thousands every year with sorrowing joy? Is there no remedy for this dire disease, which makes a household shudder, and its victim live on for a short time with an awful handicap?

Many a plan has been tried; many experiments have been made in the consumption hospitals; much skill has been exercised by the highest medical authorities; but still it has almost baffled all. Fortunately, not altogether has it defied the physician's acumen and energy. A new system is being adopted which has been partly successful in at least warding off its immediate ravages, and may yet be of great service to suffering humanity.

Dr. A. B. Griffiths, principal of the School of Science, Lincoln, has been for some years engaged in praiseworthy researches on micro-organisms (from time to time submitted to the Royal Society of Edinburgh), with the view of ascertaining if there are any germicides which will kill the microbes of lung disease. He has had the equally praiseworthy devotion to science in the assistance of his distinguished patient, Mr. John Snodgrass, of Glasgow, the translator of Heine's "Religion and Philosophy in Germany." They assumed that there is a germicidal agent capable of destroying the *bacillus tuberculosis*, which resides in the blood and carries on the work of consumption. Their endeavour was to find this agent, which, while destroying the microbes of the disease, must have very little detrimental action upon the blood. Having found such a substance, their plan was to inject under the skin a solution of the microbe-destroyer directly into the blood, so as to quell the disease.

In his investigations Dr. Griffiths was astonished to find the tenacity of life which the *bacillus tuberculosis* exhibited. Small quantities of the sputum expectorated by Mr. Snodgrass (who had been ill with acute general phthisis for thirteen years) were mixed with calcium sulphate and calcium carbonate (the principal ingredients of the common inorganic dust of the air) which had been previously sterilised at temperature of 275° Fahr. Part of the mixture was placed in twelve sterilised tubes and then hermetically sealed, and part was placed in twelve open tubes. The whole were kept at a dry heat of 90° Fahr. from one to six months. Now, what was the result?

Two of each set of tubes were opened after one month, and four tubes containing sterilised blood serum were inoculated from the contents of the tubes. The serum inoculated from the open tubes showed growths of *bacillus tuberculosis* after sixteen days; from the sealed tubes in nineteen days. After two months' exposure the same thing was done with another four tubes, with the result that the vitality of the microbes was found after twenty days' incubation in the one case, and after twenty-three days in the other. After being exposed to the dry heat for four months the vitality of this micro-organism and its spores was not destroyed; but after being heated for six months the bacillus was completely killed. From these experiments it was found that the microbes of lung disease are capable of being dried up in the dust of the atmosphere for several months without their vitality being impaired.

He has also established the startling fact that letters can carry the germs of this disease for many miles. Using every antiseptic precaution and experimenting in a closed room away from his laboratories, he shook the envelopes containing the letters from Mr. Snodgrass over a sterilised solid blood serum, at 100° Fahr. The cultivations thus initiated gave serpent-like twistings in cover-glass impressions—and under the higher powers of the microscope the characteristic form of the *bacillus tuberculosis* (a long thin tube, with alternate black and white divisions). From this, he said, that the saliva of consumptive patients used in moistening an envelope may contain the germs of phthisis and be carried without destruction over two hundred miles, so that, when a suitable medium and temperature are provided for them, they show unimpaired vitality.

It is, however, remarkable that these microbes cannot stand electricity. He made experiments on pure cultivations of the germs growing in fluid blood serum; and a current of electricity of 2.16 volts killed them. For when the current had passed for ten minutes, ten tubes of sterilised fluid blood serum were inoculated from the electrified tubercle-bacilli; and, after being kept at a suitable temperature for 25 days, *no* growths made their appearance in any of the tubes. The electric current, therefore, killed the micro-organisms.

Two years ago Dr. Bergeon tried hard to combat consumption by anal injections of sulphurretted hydrogen and carbon dioxide gases. The intestines absorbed the gases, and communicated them to the blood. By repeated injections he cured the worst cases of pulmonary phthisis. Dr. McLaughlin, of Philadelphia, cured by the same process 30 patients in the last stages of consumption. Dr. Griffiths passed a mixture of these gases through blood serum, inoculated with active bacilli-tubercles. Ten tubes containing sterilised blood serum were inoculated from the growths which had been submitted to the action of the gases, and placed in a suitable temperature. After 40 days' incubation *no* signs of any growths made their appearance in any of the tubes. Again he passed the gases into a little glass cell, containing upon the internal surface of the cover-glass a drop of sputum full of bacilli; after fifteen minutes he transferred the sputum to sterilised blood serum. After 26 days *no* growths made their appearance. The microbes were, therefore, killed by the gases.

Ever since the discovery of Koch's bacillus, Mr. Snodgrass tried various devices for destroying the microbes in his own lungs. First he inhaled volatilised iodine, and was assured that, though it may not reach very deeply into the lungs, it will cleanse the throat, larynx, wind-pipe, and bronchials. "The inhalations of iodine," he says, "have certainly put the hand back on the dial in my case for nearly two years."

M. Ball, of Paris, considers that consumption can be cured by injections of eucalyptus oil under the skin. Mr. Snodgrass inhaled volatilised eucalyptus oil, but it proved very irritating. Dr. Williams proved by experiment that the sulphate of quinine is a destroyer of the microbes of lung disease. Dr. Kolischer, of Vienna, starting on the assumption that tuberculosis occasionally heals naturally, owing to the tubercles being "calcined," hit upon the idea of causing artificial calcination by injecting under the skin of the limbs of the consumptive patient a substance described as calcium phosphoricum. In every case his experiments turned out successful.

But Dr. Griffiths has, as yet, hit upon the most successful germicide in salicylic acid. The natural acid he prepared from oil of wintergreen. Mr. William Thomson considers that the silicate of soda (so successfully used in solution for rheumatic fever) is the best germicide. Mr. Snodgrass injected a solution of salicylic acid in the calf of the leg near a large vein. It instantly removed the severe rheumatic pains which often accompany phthisis. That it passed through his system was certain, for he felt the unmistakable taste of it in his mouth next morning. He is quite sure that Dr. Griffiths' method is on the right lines. "The micro-organisms must be *reached* and must be *destroyed*." After repeated experiments on himself he is of opinion that Dr.

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Bergeon's method occasions disagreeable symptoms, as severe headache, colic pain, weakness, and slight pain of the heart. An injection of salicylic acid at once removes these. "Many persons," he writes to Dr. Griffiths, "would be far too weak for Bergeon's method, and for them your salicylic acid treatment would be invaluable, for I have not the least doubt that you have discovered an efficient bacillus destroyer."

Mr. Snodgrass found that it was best to use 2½ grains of salicylic acid to a fluid drachm of tepid water, and inject 10 minims of the solution. After persevering for a month he found himself much better, as far as phthisical disease is concerned, sleeping seven hours at a time instead of a laboured half hour. In two months more his lung trouble had so very greatly improved that he could not send his doctor a typical specimen of sputum; and ever since the salicylic acid injections he has had no attack of muscular rheumatism.

Thus, it is satisfactory to know that to some extent two germicides for consumption have been discovered, the one gaseous and the other liquid. Salicylic acid, however, appears to be the more lastingly successful. Perhaps a better germicide may be yet found, yet the principle of the method of treatment is quite revolutionary. In consumption the blood contains living bacilli-tubercles; and this system introduces into the blood by injections the microbes of salicylic acid to kill the bacilli. When the bacilli are destroyed nature will have a chance of repairing the damage done.

The war against this insidious, dire, and fatal disease has now commenced in earnest; the best medical authorities are at work to reinforce their germicidal agents, and thousands are interested in the result of the campaign. What a blessing to many would victory bring! How many who spend a living death would revive with fresh vigour! How many who now watch with feverish anxiety the flickering flame would leap with joy to know of a restorer! Suffering humanity wishes them god-speed in their noble work.

The Ascent of Water in Plants and Trees.

By the Rev. Frank Ballard, M.A., B.Sc., F.R.M.S., &c.

(Abstract of paper read at the meeting of the Liverpool Microscopical Society, on Friday, April 5th).

NOTHING confessedly contributes more to the beauty and freshness of landscape scenery than the plentiful foliage of abundant trees. Nor does the popular eye perceive much difficulty in accounting for this green wealth of nature. The trees are living, and the leaves grow out of them, that is sufficient; and, even if reminded that the life of each leaf involves and requires moisture, the ordinary observer would probably not be greatly perplexed about the water supply. There are, at all events in our climate, showers without stint, which both fall upon the leaves and saturate the soil about the roots of every herb and tree. But nature's working is not so easily transparent that every careless lounger may see through it without effort. As Sir William Thompson reminds us that we may spend a lifetime upon the study of a soap bubble, and then have most to learn, so is it yet more true concerning a leaf, that there is abundant scope for all our most careful labour and study, with the assurance that at last we shall land in hypothesis and mystery. This apparently simple matter of the water supply of leaves has not only been the subject of careful and constant investigation, but is, even at the present moment, a question concerning which the ablest botanists are at variance.

Professor Julius Von Sachs is well known as one of the foremost of continental botanists Although his style is decidedly egotistic, the merit of his works is such as to cause his name to be deservedly held in honour. It is only a few years since his "Text-book of Botany" appeared in English, and was hailed with delight by students as a reliable and abiding source of information, So rapid, however, is the march of science in our day that it is already antiquated, its place being taken by three works. These are De Bary's "Text-book of Comparative Anatomy of Phanerogams and Ferns," Goebel's "Outlines of Classification of Plants," and Sach's "Lectures on Plant Physiology." It is needless to remark that these are all German works, of which English botanists are but translators and editors. The only original English work with which we are here really concerned is that of Dr. Vines (now Sherardian Professor at Oxford) upon "The Physiology of Plants."

Ever since 1856 Dr. Sachs has been alive to the great importance and delicate difficulty of the subject mentioned above. He has published at least half a dozen distinct monographs upon it, and has gathered together succinctly the results of these investigations in his "Vorlesungen," just referred to, which have been translated by Professor Marshall Ward.

It is thus small wonder that his views upon the ascent of water in plants at present dominate the botanic world. When such men as Vines, Balfour, Bower, Ward, McNab, and others in England, together with the greater number of continental professors, acquiesce in a definite position, there seems little left for any man to say on the matter. It must not, however, be wholly forgotten that there are other workers besides Sachs; nor ought such names as Böhm, Elfving, Godlewski, Hartig, Von Höhnel, Russow, Scheit, Volkens, &c., to be lightly passed over without regard. For these, however they may differ between themselves, are yet one in calling in question the theory of Sachs, and in asking for at least renewed investigation.

It may, therefore, be interesting at this juncture to state Sachs' position, and mention some of the difficulties attaching to it. A fair acquaintance with physics and botany, with patient thoughtfulness and some little manipulative skill, appear to be all the requisites for further investigation on the part of anyone interested.

It is, of course, impossible here to give those details which are so necessary to the full comprehension of the subject. The plain, brief statements must be supposed to be supported (as they are) with careful provings.

Three distinct water-movements may be recognised in plants—

(1). The slow diffused movement from cell to cell, by means of osmosis, which is associated with turgescence and growth.

(2). That due to root pressure.

(3). That connected with transpiration.

The first of these need not here be further noticed, as will be presently shown. Concerning the second, it is only needful carefully to distinguish it from the third. The phenomena of "bleeding" of trees, &c., when cut in spring, are well known; and there can be no doubt, after the careful examining and the ingenious experiments of Sachs and others, that this is due to the upward pressure of water, in the vessels of the fibro-vascular bundles, arising from absorption of water from the soil by means of the root. The delicate root hairs are the chief agents of this absorption, the "hygroscopic film" of water on the soil particles passing first by osmosis into the cortical parenchyma, and then by filtration into the vessels, the continuance of the process causing the pressure to be necessarily upward, because there is no outlet below.

(3). Transpiration is, however, distinct from this in the following particulars. The *height* to which water unquestionably ascends in tall trees is much greater than mere root pressure could bring about. The *quantity* of water exhaled by transpiring foliage is far beyond—sometimes in the proportion of six to one—what root pressure could supply. There is, further, a definite *periodicity* in root pressure of which transpiration shows no signs.

In addition to these, Sachs especially insists on two other considerations, which, indeed, embody his own emphatic views concerning the general subject. When transpiring plants are cut through there is,

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apparently, no exudation from the vessels. From this, along with other phenomena to be presently mentioned, Sachs concludes that the water ascent in transpiration is definitely distinguished from that arising from root pressure in this—that whilst the latter goes on by means of the cavities of the vessels, the former takes place by means of the *substance of the cell walls.*

The experiments of Knight, Hartig, &c., must be here assumed. It may be taken for granted that the water-movement is upward (though Henslow has adduced facts which modify, whilst they do not disprove, this); that it ascends in the xylem, or woody portion, of the fibro-vascular bundles, and in the alburnum, or young portion of the wood; as, also, in the spring, rather than autumn, portion of the alburnum. Thus it is finally distributed to the assimilating tissue of the leaf, and brought into connection with the stomata, which regulate transpiration.

The point at issue is thus conveniently narrowed down to the simple query as to whether Sachs' view is correct, as above stated, or whether, as others affirm, the water ascends by means of the cell cavities or vessels of the wood.

It seems at first sight somewhat *outré* to make water pass upwards through solid walls when there are cavities close at hand apparently adapted for such purpose. But Sachs' position is not without strong support, as the following brief statement of his chief reasons will serve to show:—

(1). Upward passage through the parenchyma is far too slow to accord with the measurements of rapidity which have been actually taken by means of lithium nitrate.

(2). By conducting careful experiments with cinnabar in very fine emulsion, Sachs claims to have proved that the cavities of the vessels and tracheides are not in communication. The cinnabar solution issues as pure water, passing, Sachs says, through the wall substance, and leaving the cinnabar particles in the cavities that were cut through in making the upper section of the cylinder of wood, through which the solution filters. If there be no communication thus between the cavities, Sachs holds that his view is established.

(3). Capillary attraction is ruled out of consideration, because the vascular system is closed both above in the growing apex and below in the roots. Also, the known laws of capillary action would not explain the height of ascent attained, considering the comparatively large breadth of the wood vessels.

(4). It has been mentioned above that, when transpiring plants are cut through, fluid does not at once exude from their vessels. Sachs considers this as pointing to their emptiness. To support this he remarks that a piece of wood freshly cut out of a transpiring plant floats, whilst after a while it sinks because it absorbs water into the vessels.

(5). Two other experiments have been specially relied upon by Sachs. When a twig of hops or flax is sharply bent—so sharply as to completely close the cavity of any vessel in its F. V. bundle—it is yet found that the leaves above the bend do not wither, whence it follows that somehow they must receive water, which must come through the walls of the vessels if their lumina are closed.

(6). Yet, again, taking a cylinder of fresh-cut wood, with two smooth planes of section, and holding it vertically, Sachs asserts that a drop of water placed on the upper section at once reappears in similar quantity on the lower section. This is due, according to Sachs, to the small absorption power of the cell walls, along with the extremely facile mobility *(verschiebarkeit)* of the "water of imbibition." Thus he concludes that "wood is a body *sui generis*, and especially adapted by nature for the purpose of conveying water from the roots up into the transpiring organs."

(TO BE CONTINUED).

Variation in Plants.

FEW subjects are of more profound interest to theoretical and practical horticulturists than the observations of variation in plants. On the 2nd ult. Professor Bayley Balfour read a most interesting paper on the subject to the members of the Scottish Horticultural Association, Edinburgh. He stated that his subject was the most discussed in the scientific world at the present day among biologists. "Are acquired characters transmissible from one generation to another?" In a recent number we gave same notes upon Mr. Thomson's investigations on the transmissibility of character from one generation to another in mankind. So, both with regard to plants and animals, the topic is absorbing a considerable amount of scientific attention. A new view has arisen on the subject, advanced by Professor Weissman, Germany, to the effect that, in order to have variation, the only way in which it could be effected was by means of sexual intercourse; but, Professor Balfour asked, if it was only by this means that they had got this power of variation at the present day, how was there ever any power of variation at all? This question awaits settlement; and all horticulturists are asked to pay more attention to this subject than they have been doing, and to record the results of their careful and impartial observations. It is a question of very great importance to know if there is any evidence that these acquired habits of plants are or are not transmissible. Mr. Thomson—in his duplicate cell theory, in the matter of human transmitted character—has fairly answered Weissman's limited theory as to the human race; and Professor Balfour is equally certain that Weissman is wrong with regard to plants. The Professor is strongly inclined to think that they would eventually get evidence in favour of the transmission of acquired characters and habits, though he was honest enough to say that he had not any particular case sufficiently strong to illustrate or corroborate his theory. Very likely the cell theory of Thomson will be the true solution of the question in the case of plants as in the case of animals; one set of cells develop individual traits, another set of cells develop hereditary traits. The subject is very interesting; and practical horticulturists, as well as biologists, should keep a careful watch upon the development of plants and animals with a view to the solution of this important matter.

Professor Tait on the Duration of Impact.

AT the meeting of the Royal Society of Edinburgh, on the 1st ult., Professor P. G. Tait contributed a most interesting paper on the "Duration of Impact." On this subject very hazy ideas have been expressed in the several text-books by even good authorities. Very different notions have existed with regard to the time that a bat is in contact with the ball in the game of cricket, or that a golf-club touches the ball in golfing. Some held that they remain in contact only a millionth of a second, while others jumped to the opposite extreme, and said they were in contact for the tenth of a second. Some golfing authorities were of opinion that the player carried the ball along with the club (after the impinging of the club on the ball) for a quarter swing, or several feet, which would involve more time in contact. On account of the general vagueness of men's ideas on the subject, the Professor constructed an apparatus for actually measuring the time of impact, so as to come to some definite solution of the question. He was able to carry out his investigations by aid of a grant from the Government. He first employed wood for his experiments; and the very earliest experiment showed that the time of impact, with a block of six pounds falling upon a piece of wood of the same kind, was exceedingly small—very little more than a thousandth of a second. After careful verification of the experiment, he was quite convinced that he had come to something like a definite limit to the time of impact. Not only did he pay attention to the matter of time, but to the variation which took place according to its circumstances. A remarkable fact was deduced after particular

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experiments, that when the speed of the impinging body was very great, the bodies remained longer in contact. There was a great distinction between two classes of bodies—between wood substances on the one hand, and highly-elastic substances, such as india-rubber and cork, on the other. When he let plane-tree wood fall a distance of two feet upon a block of plane-tree, the duration of impact was fully the thousandth of a second. When from the same distance a piece of plane-tree fell on teak, the time was exactly the thousandth of a second. But in the case of cork—such as an ordinary bung—the duration (for the same height) increased five times; and when good cork was used the duration was more than the fiftieth of a second, or twenty-fold. He also observed that the best cork gave the longest time of impact between two impinging bodies. He promised to continue his investigations, and report the, no doubt interesting and valuable, results to another meeting of the Society.

Museum Notes.

SOUTH KENSINGTON MUSEUM.—During the past month the Saturday afternoon lectures have been continued with considerable success. Mr. Eadweard Muybridge, of the University of Pennsylvania, lectured on "The Science of Animal Locomotion in its Relation to Design in Art," illustrated by the zoopraxiscope and illuminated photographs of the consecutive phases of animal movements. "Decorative Glass" was the subject chosen for the lecture, by Mr. J. Hungerford Pollen, delivered on the 6th April. Our readers will be interested to learn that the admirable series of lectures on "Artistic Ironwork," lately given at the same place by Mr. J. Starkie Gardner, will shortly be published by the Department as one of their useful "Handbooks." It has been suggested that these lectures should be given in the evening instead of the afternoon, in order that students and others should have a better opportunity of hearing them. The charge for admission, viz., one shilling per lecture, seems somewhat high, considering that so many institutions in the country grant free admission to their museum discourses, with the view of popularising the public with the contents of their various scientific collections.

MR. MUYBRIDGE'S lecture, mentioned in the preceding paragraph, proved both novel and attractive. Since the first experiments in recording the motions of animals by means of instantaneous photography were brought under notice in this country, further investigations have been made with animals of many different species. These have shown that the customary "artistic" notion of movement in animals, such as horses, dogs, mules, &c., is entirely wrong, and the pictures of the future, to be scientifically accurate, will have to be based upon the motions exhibited in Mr. Muybridge's photographs.

A NEW Museum of Natural History is to be opened at Vienna during this summer. Great preparations are being made to have the objects in readiness and the collections worthily arranged.

THE Zoological Museum at Copenhagen has lately been enriched with a number of ethnological remains from Lagoa Santa, Brazil, consisting of human bones found in some caves. Fifteen skulls, in a more or less entire state of preservation, have been deposited, together with some other fragments of bone. No implements have been discovered associated with these remains, so that their antiquity remains uncertain, and the absence of bones of contemporaneous animals adds to the difficulty of determining the age of the race of people to whom they belong. They have been referred, however, by Mr. Quatrefages to a Papuan type.

THE authorities of the Museum at Leyden issue periodically a journal, under the title of "Notes from the Leyden Museum." The number for January contains some valuable entomological articles, besides papers on botanical and zoological subjects, the most important being an account of a collection of mammals from East Sumatra made by Dr. B. Hagen, the well-known traveller.

THE Leyden Museum was the scene of a disastrous occurrence on the 1st April, a fire which broke out having destroyed a considerable portion of the collection of ruminants in the zoological department. It is not often that we hear of a fire at a museum, special precautions being usually taken to guard against accidents of that nature; still this event shows the necessity of being always watchful.

THE city of Dublin will shortly have a fine group of buildings for the purposes of a museum, which will be worthy of that important capital. The cost of erection is expected to be over £190,000, or nearly thirty thousand pounds in excess of the original estimates. It is said that the exterior of the new buildings will accord with the architecture of Leinster House, which is rather of the "severe" order, but that the architect has had full scope for his invention in the interior portions of the edifice. The museum is to be elegantly fitted up with all modern appliances and requirements.

ONE of the most noted art galleries in the North, at Glasgow, has been especially unfortunate in regard to conflagrations. No fewer than four fires broke out in the same number of years. When the great value of the different objects, whether of art or science, usually gathered together in such institutions is considered, it becomes in the highest degree essential that every possible precaution should be taken to mimimise the risk of fire, not only by a strict supervision of all lighting and heating arrangements and the provision of appliances for use in case of an accident, but also by the regular drilling of the staff, as is done in some other places of public resort, so that, when necessity arose, each man should be at his post with the means at hand of rendering efficient assistance.

NEARLY every museum contains some object or group of specimens that is of unique interest, the loss of which would be irretrievable. It is surprising that curators do not, as a rule, take advantage of photography as a means of preserving at least the lineaments of some of their priceless possessions. Rare works of art, antiquities, fossils, and all "type-specimens" should be photographed, and an accurate representation of their form thus preserved.

A SET of such photographs illustrating the chief treasures of a museum would form an excellent and valued "exchange" sent to some neighbouring institution, and, moreover, if judiciously circulated, would be an admirable means of directing public attention and arousing greater interest in the more important objects which the museum possessed.

VISITORS to the little cottage at Walkley, Sheffield, wherein is stored all the wealth of the Museum of St. George, endowed by the choice gifts of Mr. Ruskin, will miss the genial presence of its late curator, Mr. Henry Swan, who died recently at the age of 68. Mr. Swan held the post for the past twelve years, long before which period he had earned a world-wide reputation as the engraver of the plates in *Modern Painters*. He also invented several pieces of mechanism—an improvement in photography, a system of musical notation, and a system of phonetic writing. He was always courteous and obliging in his relations with the public.

RECENT ADDITIONS TO THE LIVERPOOL FREE PUBLIC MUSEUM.—Mr. Henry C. Duncan has sent to the museum, as a donation from Mrs. Ellen Parkinson, lately returned from Sydney, N.S.W., a small but valuable collection of shells, corals, &c., collected by herself; and also, from the same donor, a chief's grass dress, a long spear, hatchet, bows and arrows, and stone club, from the German territory of New Guinea. Mr. Asahel P. Bell, C.E., has offered for exhibition three very interesting specimens of pictorial needlework (in silk) supposed to be English, of 16th or 17th century. They are remarkable for their colour, design, excellence of workmanship, and variety of stitches employed to produce effects of widely different character. The largest represents in a striking manner the sacrifice of Isaac; the next in size appears to represent the Tree of

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Life of Scandinavian mythology; and the smallest a varied assemblage of natural objects. They were purchased at the sale of the noted hostelry of Lancaster, and references are said to be made to the first and second by Ruskin in his *Fors Clavigera*. Mr. Asahel Bell, who has been engaged for some years in the construction of the Central Railway of Chubut, Eastern Patagonia, has also offered for exhibition a variety of objects of interest from that country, including, besides a few natural objects, a series of ancient chipped arrow-heads—an art now lost to the Indians of the present day—a variety of silver ornaments, ancient and modern, and a selection from a large series of ponchos, rugs, braids, tapes, and other articles for personal use and adornment. These are woven by the women, and display considerable neatness and skill in the manufacture as well as in the brilliancy of colour and variety of design, no two examples being of the same pattern, thus displaying much taste and originality in primitive art. Various accompaniments of the chase, as of the guanaco and the rhea, or American ostrich, are also added.

LIVERPOOL MUSEUM.—The winter series of evening lectures on Mondays (on which day of the week the museum has been open from seven until ten o'clock since the 1st October) is now discontinued. The results of this modern resuscitation of an old system, which was tried and abandoned some years ago, have been most encouraging and successful. Mr. Moore, the curator, reports to his committee that, during the period from October to the end of March, the attendance on Monday evenings has been 8,044, or an average of 309 per night. The conduct of the visitors was uniformly good, and was in marked contrast to the levity of behaviour which caused a previous experiment to be discontinued. The attendance during the season on the former occasions reached 23,000.

THE Whitworth gifts to Owens College have been augmented by a further grant of £10,000 from the legatees, to be added to the Museum Trust Fund. This fund consists of the property of the Manchester Natural History Society, in Peter Street, handed over in the year 1868 by that society to the Owens College in trust for the endowment of the Natural History and Geological Museums. The total amount of this fund is now £24,589, and the income accruing therefrom will be applied to the maintenance and extension of the Manchester Museum. In October last, it will be remembered, a grant of £25,000 was made by the Whitworth legatees to the building fund of the museum, which now forms an imposing-looking part of the Owens College extension buildings.

A LARGE party of members of the Manchester Geographical Society and Scientific Students' Association lately visited the new Geological Museum at Owens College, where they were met by Professor Boyd Dawkins, who addressed them from the stairs of the gallery. The Professor pointed out how the museum might be used to the best advantage by visitors, comparing the place to a library well stocked with good books. A person coming to the museum simply to gaze with wonder at the objects would not go away with much increase of knowledge. He should try to clothe the dry bones of antiquity with life, and should make one object a centre from which his observations would entend and eventually continue to the end of life.

THE Manchester Museum is so fortunate as to possess the finest specimen of *Ichthyosaurus* yet found in this country. There is one in the British Museum about 24 feet long, and another fine example at York, but the Manchester specimen is about the same size as the one in London, and is considered to be much more perfect.

A COMMERCIAL Museum on an entirely new system has been lately established at Liege by the Chamber of Commerce of that city. The new museum is divided into two sections, in one of which are displayed articles that Belgium is obliged to purchase from other countries, while in the other are contained samples of all articles that are manufactured in Belgium. A library and an information bureau are also attached to the museum.

Botanical Congress at Paris.

IT is officially announced that the *Société Botanique de France* has decided to hold a Congress at Paris in the month of August, to which will be invited a large number of distinguished foreign scientists visiting the French capital for the great Exhibition. The congress will also be open to all who are interested in botany, and in the present state of this science such a step will be in every way desirable and likely to lead to good results, for an occasion which brings together so many representatives from all nations does not often occur. It will be remembered that the recent International Congress of Geologists was most successful, and this has, no doubt, induced the leaders in other branches of science to adopt a similar means of applying themselves to the solution of many questions interesting to the whole of the scientific community. The Paris Botanical Congress will, amongst other matters, deal with the preparation of accurate maps and charts illustrating the distribution of species and genera of plants all over the globe. This work is analagous to the cartographical work accomplished for geological science by the International Geological Congress. Another subject to be discussed will be the establishment by different local societies of botanical museums. It is also proposed to arrange an exhibition of maps, books, photographs, &c., relative to geographical botany. The important question of the classification of plants by their physiological characters will be brought prominently before the notice of the congress. Those who wish to attend, or to take part in the congress, should send in their names before the 1st June to the secretary, M. P. Maury, Rue de Grenelle 84, Paris, who will issue an invitation to the congress, and will be glad to receive particulars of papers or communications. A strong committee has been formed, of which M. H. de Vilmorin is president.

Notes in Brief.

THE Spring Exhibition of the Royal Botanical Society was remarkable for an unusually fine display of early roses, azaleas, and auriculas. Some fine specimens of amaryllis, peonies, cinerarias, and orchids were also shown, and the Exhibition itself was a great success.

IT is announced that the Selborne League now numbers 2,000 members, all of whom are pledged to protect from unnecessary destruction such wild birds, animals, and plants as are harmless, beautiful, or rare.

AT a recent book sale, a copy of Audubon's *Birds of America* realized £315. There is some commercial value even in scientific books, after all.

MANY complaints have been made regarding the serious delay in transmission of telegrams owing to the break-down of overhead wires during storms, and the use of underground wires has been strongly advocated. The Postmaster-General recently informed a correspondent that the advantages of laying wires underground are fully appreciated by the department, and a considerable mileage of underground wires already exists; but the system is so much more costly than that of carrying wires overhead as to preclude its indefinite extension.

THE Twentieth Annual Conference of the National Union of Elementary Teachers was opened on Monday, April 22, in the Town Hall, Birmingham, when the President elect, Mr. R. Wild, delivered an Address on the Report of the Education Commission, and on the latest edition of the Code. In a discussion at a crowded meeting, on Tuesday evening, Mr. Chamberlain spoke of payment by results, in the sense in which the phrase is now used, as a method which everyone condemns.

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THE Royal Meteorological Society held this year an Exhibition of more than the ordinary attractiveness. Amongst the varied collections of objects and apparatus that were exhibited, perhaps the greatest interest was aroused in a series of novel instruments for measuring the duration of sunlight and the variations of the intensity of the solar heat.

A NEW explosive has just been produced from carbolic acid, and is, of course, said to be more powerful than any hitherto discovered. Three charges of this explosive, so it is asserted, shot out of mortars will suffice to shatter to pieces a strongly-constructed fort. It is by operations such as these that science tends eventually to exterminate war; for war, under conditions of absolute mutual destructiveness, becomes an impossibility.

ANOTHER formidable piece of naval ordnance has been designed by Mr. W. R. Cavett, of Pittsburgh. It consists of a submarine ram, and is to be propelled by a force of steam equal to from 50 to 150 tons—sufficient to pierce the sides of the heaviest ironclad afloat. The vessel is to be manned by a crew of six men, and is specially designed to be carried on board a man-of-war, for use either in the open sea or for harbour defence.

AN invention, brought out by Dr. B. W. Richardson, will appeal to all advocates of humane treatment of animals. The agonies of those unfortunate animals, such as dogs or horses, injured in the street are frequently painful to contemplate, and some time has often necessarily to elapse before they can be removed and their sufferings ended. Dr. Richardson has invented a lethal muzzle, by which injured animals may be killed in few minutes as painlessly as in the lethal chamber.

FROM recent official returns we learn that the total number of persons engaged in mines and collieries in the United Kingdom is 592,656, of which 5,680 are women. The total quantity of mineral raised by their exertions during the past year was 182,660,163 tons.

THAT gigantic monument of French constructive perseverance, the Eiffel Tower, is now completed, and rears its summit 984 feet above the Seine. The effect of the structure is now acknowledged to be imposing, and not such as to detract, as was originally feared, from that of the other great monuments of the city.

AN Exhibition of Sanitary Apparatus will be held at Worcester in September, in connection with the Congress of the Sanitary Institute.

A NEW building has been erected at Woking for use as a crematorium. The architecture is 13th century Gothic, and the body of the building is in red brick, with Bath stone facings. It is not generally known that, by a donation of ten guineas to the Cremation Society, any person can ensure cremation without further payment. The total number of persons cremated in 1888 was twenty-seven, of whom fifteen were women.

THE newly-formed Boulder Committee of the Liverpool Geological Society have not been long at work before discovering that their investigations would be better carried out if extended over the whole of Lancashire and Cheshire, and by a larger committee, consisting of representatives from all parts of the two counties. It is, therefore, suggested to hold a general meeting of Lancashire and Cheshire geologists to discuss the matter, with the view of forming a general working committee for these counties. The objects of the proposed committee are thus set forth in a circular which has been issued inviting co-operation of geologists:—"To examine and record the occurrence, nature, and facts bearing on the mode of transport of erratics in the glacial deposits of Lancashire and Cheshire,"

THE famous carved figure in the Chalk Hills, near Eastbourne, known as the "Wilmington Giant," is about to be restored. The figure is that of a man, 230 feet high, and is a familiar object on the south-coast line of railway. It is of great antiquity, and, although believed to be of Celtic origin, its date or purpose has never been definitely ascertained. The "Long Man" (as the figure is familiarly termed) poses in an attitude similar to that of the Colossus of Rhodes; he carries a staff in each hand, the distance between them being 119 feet. On many archæological grounds it is desirable to have the figure preserved, so far as may be possible, from the destructive effects of time.

A PROPOSAL to admit women as "fellows" of the Geological Society of London has been rejected by the Council by seventy-nine votes to twenty-three. Women are not admitted to the meetings, even as visitors.

THE only candidate for honours in Natural Science this year at Oxford happens to be a lady. Special arrangements had to be made for the appointment of an examiner in this subject for her.

AT the recent examination of the Royal College of Surgeons, Dublin, Miss Emily Winifred Dickson took first place in senior practical anatomy.

SEVERAL conferences, having various social as well as scientific objects, will be held in Paris this year, during the continuance of the Great Exhibition. One of these will be an International Congress of Women, which is to be presided over by Madame Clemence Roger, the translator into French of Darwin's *Origin of Species*.

THE public purse has been appealed to pretty frequently of late on behalf of the families of deceased literary and scientific men. The fund for the benefit of the widow of Mathew Arnold has, we learn, reached the sum of £7,000, out of which £600 is to be expended in a bust of the deceased author, to be placed in Westminster Abbey. A sum of £2,000 has also been collected for the family of the late Rev. J. G. Wood, the most popular of the writers on natural history. Other appeals have also been made, the results of which have not been, in every case, made known to the public.

A DISCOVERY of some archæological interest was recently made upon the Barton section of the Manchester Ship Canal. At a depth of 25 feet below the surface an old wooden canoe was brought to light during the excavations. Its length is 13 feet, and it bears no trace of nails or ironwork. This relic rested on a bed of sand and leaves, amongst which were some hazel nuts. Large trees are also found in the vicinity. The age of this relic is not precisely ascertained, opinions varying from "prehistoric" to "Saxon."

A NEW School of Science and Art has been opened at Rotherham, and classes will now be held regularly in the building. The total cost has been £2,170, towards which the Government have promised a grant of £840. The school contains metallurgical and chemical laboratories, rooms for plaster casting, modelling, art lectures, mathematics, mechanical drawing, and chemical lectures. A formal opening will take place early this month, at which Earl Fitzwilliam, K.G., will perform the ceremony.

MEMORIALS in favour of the system of Continuation Schools continue to pour in upon the Education Department. Nearly 4,000 memorials have already been presented from co-operative societies, trade unions, and various educational bodies. They urge that (1) children shall not obtain total exemption from day-school attendance

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till they are thirteen years of age; (2) that the age of half-time exemption shall be raised to eleven years; and (3) that continuation schools shall be made an integral part of the elementary system of education, and that these schools shall be adapted to the need of working boys and girls, so as to attract and interest tired children and prepare them for the actual duties of life.

THE foundation stone of a new Free Library has been laid at Hull. The institution will cost £12,000, and is entirely the gift of Mr. W. F. Reckett, (of "Reckett's Blue" fame). It appears that the ratepayers of that seaport do not possess sufficient faith in the blessings of the dissemination of literature by means of Free Libraries, for they have twice rejected the Free Libraries' Act. Hence, Mr. Reckett has magnanimously come to the rescue.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between March 16th and April 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board:—

(*a*) Barometer	Highest (March 16th)	30·53	Inches.
,, ,,	Lowest (March 20th)	28·77	,,
,, ,,	Mean	29·812	,,
,, ,,	,, for 22 years March	29·923	,,
,, ,,	,, April	29·891	,,
Temperature	Highest (March 24th)	57·8	Deg. F.
,,	Lowest (March 26th)	31·9	,,
,,	Mean	42·9	,,
,,	,, for 22 years March	41·8	,,
,,	,, April	47·2	,,
,,	,, of Evaporation	40·3	,,
,,	,, for 22 years March	39·1	,,
,,	,, April	43·5	,,
(*b*) Rainfall	Amount	3·167	Inches
,, ,,	Mean for 22 years March	1·712	,,
,, ,,	,, April	1·587	,,
,,	Number of Days on which Rain fell	23	
,,	Greatest fall in 24 Hours (March 19th)	0·512	Inches
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	8·5	
,,	,, ,, for 22 years March	6·5	
,,	,, ,, April	6·4	
(*c*) Wind	Velocity, Greatest (April 1st)	49	Miles.
,,	,, Least (April 15th)	1	,,
,,	,, Mean Hourly	18·3	,,
,,	Greatest Pressure on Square Foot (April 1, 2·55 p.m.)	24·0	Pounds.
,,	Direction at time of Greatest Pressure	W	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
89	144	57	21	72	219	84	58	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

The weather during the third week in March was generally unsettled, the range in barometric pressure from the 15th to the 20th being 1·764 in. The steep inclines following the anti-cyclone gave rise to strong winds on the 20th, Averages for the week:—Barometer 29·826 in.; corrected mean temperature 40·09°; rainfall 0·537 in. on four days; sunshine 8 hours 45 minutes on six days. Wind W. and N. From the 22nd to the 31st more settled weather prevailed, with several mild Spring days, the mean temperature of the 24th being 48·25°. Average barometer 30·105 in.; corrected mean temperature 42·65°; rainfall 0·854 in. on eight days; sunshine 35 hours 7 minutes on six days; prevailing wind Westerly.

The means or totals for March were:—Barometer 29·957 in., with nine oscillations; corrected mean temperature 38·87°, or 3° higher than in 1888, and slightly above the average; relative humidity 83·4%; rainfall 2·599 in. on 17 days; duration of bright sunshine 71 hours 17 minutes on 22 days; prevailing winds Westerly and Northerly; half a gale during the night of the 24th; thunder and lightning on the 31st; frost registered on 10 nights in the shade.

During the week ending April 7th the weather was somewhat changeable. Barometer below the average. Temperature about 3° below average. Cloudy, with frequent showers of rain, and gentle to moderate Easterly breezes. Mean barometer 29·615 in.; temperature 40·41°; rainfall 0·885" on six days; duration of sunshine 9 hours 26 minutes on five days. During the second week barometric pressure was much below the average, with slight range; temperature about 4° below the average; the weather dull and humid; owing to a settled system of high pressure over Scandinavia the wind was persistently Easterly or Northerly, and little change took place in vegetable growth. The means were:—Barometer 29·605 in.; temperature 39·9°; rainfall 0·591 in. on four days; and only 1 hour 10 minutes sunshine on three days.

The following table gives the accumulations of rainfall, of growing temperatures, and of duration of bright sunshine from the 1st January to the 14th April inclusive for the last three years, and the 20 years' average at Marlborough:—

	1887.	1888.	1889.	Marlborough.
Growing temperature	351·5°	219·7°	286·2°	318·9°
Rainfall	5·740 in.	8·161 in.	8·619 in.	9·447 in.
Sunshine	221 hrs.	152 hrs.	149 hrs.	No record.

Taking into consideration that we are about 2° further North than Marlborough, the difference in "growing temperatures" may be considered as the average for the Bolton district. The higher amount in 1887 was altogether peculiar, and, as agriculturalists will remember, the abnormally low rainfall prevented the sunshine and heat from benefitting them. Taking the figures altogether there is much promise in the present outlook. W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, April 15, 1889

Sheffield.

METEOROLOGICAL SUMMARY.

March, 1889.	TEMPERATURE. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for March. Daily Max.	Daily Min.	RAINFALL. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date	Mean for Mar.* Ins.
Sheffield ...	58°	24th	21°	4th	40°	—	—	4·24	12	1·48	19th	—
Spurn Head.	55°	29th	27°	4th	39°	—	—	2·59	14	0·81	20th	—
York	62°	29th	23°	4th	40°	49°	34°	2·29	13	1·10	8th	1·63
Barrow	50°	29th	26°	3rd	40°	—	—	2·08	18	0·49	19th	—
Liverpool ...	58°	24th	25°	4th	41°	47°	37	2·06	18	0·62	8th	1·09
Holyhead ...	56°	29th	29°	4th	43°	48°	39	1·57	21	0·30	24th	2·21
Oxford	61°	29th	23°	4th	41°	49°	35°	1·86	10	0·46	8th	1·52
London	60°	24th	20°	4th	41°	51°	30	1·56	15	0·35	7th	1·43

* The means of Temperature and Rainfall for March are for 15 years.

March 16 to April 15, 1889.

PRESSURE.

On March 16th the barometer ranged from 30·0 in. in the N., where it was giving way, to 30·5 in. in the S., where it was rising, and it kept above 30·0 in. on the 17th, though slowly giving way in the S. On the 18th it had fallen decidedly, and was between 29·8 and 29·9 in., falling to 29·3 in. on the 19th, and as low as 28·8 in. on the 20th, when

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the centre of a deep depression was over the midland and southern counties. On the 21st the depression had passed to the S. and the barometer was rising, but still rather low, and on the 22nd it had reached 29·9 in. in the N. and 30·1 in. in the S. It fell on the 23rd to 29·5 in. in the N., but was above 30·0 in. in the S., and continued much the same on the 24th and 25th, rising on the 26th to 29·8 in. in the N. and 30·1 in. in the S. On the 27th pressure was high and even, being 30·3 in. in nearly all places, and continued above 30·0 in. in most parts of the kingdom till the 31st. On April 1st it had fallen and ranged from 29·6 in. to 30·0 in., and there was a slight increase on the 2nd but a further fall on the 3rd, when pressure ranged from 29·7 to 29·9 in., and it continued to give way on the 4th, and the centre of a depression was over the S.W. part of the country, the barometer reading 29·1 in. On the 5th the depression had travelled to the English Channel and pressure was recovering, and continued to do so on the 6th, being 29·6 in. in nearly all places. There was very little change on the 7th, 8th, 9th, 10th, 11th, and 12th, pressure being remarkably even and low for a week. On the 13th it had improved and reached 30·0 in the N. and 29·7 in. in the S., and remained the same on the 14th but rose on the 15th, when it was between 29·9 and 30·0 in. all over Britain.

The Weather.

During the week ending March 22nd the weather was changeable and unsettled, and there were heavy falls of rain, especially on the 19th and 20th, when serious floods occurred. More than two inches of rain fell at Sheffield on those two days. On the 21st there was snow or sleet in many places and temperature was very low, with sharp night frosts and strong winds. There was rain on four days at Spurn, Barrow, Liverpool, Holyhead, and London, and on three days at Sheffield, York, and Oxford. From the 23rd to the 29th the weather continued unsettled, though the rainfall was not so heavy. Temperature fluctuated considerably, being high on the 24th, the readings exceeding 60° in many parts of England, and as high as 66° at Aberdeen; but the next two days there was a decided fall in temperature and snow was experienced in Scotland, but at the end of the week the air again became milder, and the thermometer registered 60° in several places. There was rain on six days at Barrow and Holyhead, five at London, three at Spurn, York, and Liverpool, and two at Sheffield and Oxford. From March 30th to April 5th the weather generally was dull, with light showers of rain and, at times, snow. Temperature varied but little and the air was close. Thunderstorms were prevalent over the southern half of England on the 5th. There was rain on seven days at Liverpool, six at Spurn, York, Barrow, and Oxford, five at Sheffield and Holyhead, and four at London. From April 6th to the 15th (ten days) the weather was continuously dull and often very gloomy, with cold, light easterly winds, and rain almost daily till the 13th, when there was some improvement in the weather. Rain fell on nine days at Oxford, eight at Liverpool and Sheffield, seven at York and London, six at Spurn, and five at Barrow and Holyhead.

Sun Spots.

There have been few indications of solar activity between March 16th and April 15th. The spots visible on the 15th could still be seen on the 16th, when they were very near the western limb. On the 18th the sun was spotless, and continued so on the 21st, 22nd, 25th, 27th, and 29th, those being the only days that observations could be taken, owing to cloudy weather intervening. On April 1st a small spot appeared just within the periphery on the eastern side above the equator, and this spot was visible again on the 2nd and 4th further on the disc, and on the latter date the nucleus was elongated and the penumbra large. On the 11th this spot had disappeared, but another group of small spots (probably four) was seen above the equator and about 10 from the eastern limb. These spots were very faint and had disappeared the next time the sun was visible, which did not occur till the 15th, when the sun was spotless.

Astronomical Occurrences in May.

The Moon enters her first quarter at 6-42 a.m. on the 8th, is full at 6-42 a.m. on the 15th, and enters her last quarter at 9-53 p.m. on the 21st. She is new at 5-20 p.m. on the 29th. Mercury is an evening star and does not set till 10 o'clock towards the end of the month, when it may be seen near the horizon after sunset. Venus comes into inferior conjunction with the Sun on the 1st, and may be seen in the early morning after the middle of the month. Mars is invisible. Jupiter rises shortly before midnight at the beginning of the month and at 10 p.m. at the end, but it does not attain any great altitude. Saturn is visible all through the month until shortly after midnight.

E. Howarth, F.R.A.S.

Museum and Observatory, Sheffield, April 20, 1889.

Notes in the Parks.

By H. Leaton Edwards, F.I.C., &c.

Owing to the cold weather the past month has not effected as great a change in the general aspect of the parks as is generally to be seen during April. With a few exceptions the trees remain destitute of foliage, so that lessons may still be learnt from the opening buds. It is only at this time that the stipules of the hawthorn and other thorns, as well as the mountain ash, pear, apple, &c., can be seen, as they fall away during the unfolding of the leaves. Also, the different ways in which the leaves are disposed in the bud—the varying ways in which they are coiled, folded, overlapped, &c., either *per se* or *inter se*—must be studied now or left till another year has passed. The lilac, elder, mountain ash, horse chestnut, and flowering currant will furnish material for a few evenings' work.

The last-named plant—botanically *Ribes sanguineum*—is one of the few shrubs, excluding the catkin-bearers, now in flower. Its pendulous racemes of rose-pink flowers and five-lobed fragrant leaves are so well known as to need no introduction. Cold as the weather has been, the plants—especially in sheltered situations—are covered with the graceful blossoms, and their soft, pink hue offers a pleasing contrast to the bare branches of the neighbouring bushes. The most prominent part of the flower is the rose-red calyx, covered with glandular hairs, which are suitable objects for the microscope, as are also the hairs on the leafstalk. The corolla is inconspicuous, consisting of five small, very pale pink petals.

The cold nights and keen winds have prevented the almond trees from making their usual show of blossom. In more favourable seasons their lavish production of beautiful pink flowers makes them very conspicuous in the early spring—often even in February. The tree is probably a native of Western Asia and Northern Africa, but is now distributed over almost the whole of the warmer temperate zones of the whole world. In Palestine it appears to have been cultivated from the earliest ages, for it is enumerated among the best fruits of Canaan sent into Egypt as a present for Joseph, 3,500 years ago. Its cultivation in England—solely as an ornamental tree, as the climate is not sufficiently warm to perfect the fruit—only dates from the year 1562. The fruit is a "drupe," or "stone fruit," *i.e.*, it consists of a "stone" surrounded by a tough, fibrous layer enclosed in a downy skin. The stone contains the seed, or "kernel"—a "colonel," according to a candidate in a recent botanical examination—which is the portion so much esteemed at the dessert table, in spite of its great indigestibility. Bitter almonds are the produce of a variety of the almond tree. They contain small quantities of prussic acid; hence the danger attending the use of oil of almonds as a flavouring ingredient, unless it is specially prepared.

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If June is the month of roses, surely April may claim to be the month of catkins. Pre-eminent among the catkin-bearing trees, on account of their number and hardihood, are the willows. The ordinary observer of country objects, if asked to enumerate the various kinds of willows that had come under his notice, would probably not be able to recall more than half a dozen, if so many. Sir W. J. Hooker, however, puts the number of native British willows down at 70, Babington only admits 57, and Lindley reduces it to 30, the last two considering as mere varieties some which were considered to be distinct species. More recently the number has been reduced to less than 20.

The study of the genus clearly involves difficulties which only the enthusiastic botanist will care to face. First, there is the production by most species of their flowers before their leaves; second, the barren and fertile catkins not being on the same plant; and third, the existence of many forms intermediate between acknowledged species.

Most species are water-loving, but a few grow high up in the mountains, and they are found further north than any other shrubby plants. They vary in height from 80 feet to a few inches, and grow readily and rapidly from cuttings. The bark is stringy and tough, and has been made into paper. It contains a bitter principle called *salicine*, possessing nearly the same medicinal properties as quinine. The catkins while opening resemble large silky buds. When open the barren catkins are recognisable, even at a considerable distance, by their golden yellow colour. The silvery scales, each partially enclosing two to five stamens with yellow anthers, and their accompanying honey glands, will well repay a careful examination. The trees bearing the fertile catkins have a more sombre appearance, each flower consisting of a dark green, elongated flask-shaped pistil, provided with two stigmas, protected by a scale, and having a honey gland at its base. Unlike other catkin-bearers, the willows are insect-fertilised (*Entomophilous*). On a bright warm day, even at the end of March, the bees resort in swarms to the fragrant catkins for a spring meal. As at this season of the year their "combs" are likely to be exhausted, and there are no other flowers in bloom capable of yielding a considerable supply of food, the value of willow-bushes near hives can scarcely be over-stated. In ancient times, when sugar was not such a commonplace article as it is now, and consequently honey was more thought of, willows were commonly planted in apiaries for the express purpose of affording nourishment to the bees at this critical season. The blossom is sold in markets an shops as "palm" on the Saturday before Palm Sunday, but nine out of ten among the purchasers buy it in imitation of others, and without an idea as to what tree produces it. The seeds ripen early, and, each being provided with a tuft of soft downy hair, they furnish many of the feathered tribe with a soft warm material for lining their nests, all the more valuable from the fact that no other downy seeds are yet ripe. Like many other trees the willow is liable to the attacks of a gall-fly, which lays its eggs in the young twigs. Hard, irregular masses of tissue—best seen in winter, when not hidden by the leaves, near the extremities of the branches—develope in consequence of the irritation. In a similar way are produced the red fleshy excrescences so often seen on the surface of various willow leaves. The foliage serves as food for the caterpillars, of many moths, and of a few butterflies. Others pierce the stem and feed upon the wood itself, causing great injury to the tree—notably the caterpillar of the goat moth, a red and yellow creature, the size of one's forefinger, and exhaling a powerful, disagreeable odour. The female goat moth deposits her eggs in the crevices of the bark of the tree. In due time they are hatched, and the young caterpillars bore their way into the tree, where they spend four years, apparently never ceasing to eat, and boring their tunnels through and through the solid wood. As the tunnels increase in size with the development of the caterpillar, and as a great number of the larvæ generally inhabit one tree, it is no wonder that many trees are killed by them.

Our Portrait Gallery.

XI.—PROFESSOR SIR WILLIAM THOMSON, M.A., LL.D., D.C.L., F.R.S.

AMONGST those who have rendered themselves notable for their original work in discovering nature's always more or less hidden processes—which we term "laws"—and also for the manner in which they have applied these discoveries to the practical needs of our present civilisation, the name of SIR WILLIAM THOMSON will ever take the highest rank. And we would further venture on the remark that it was by the force of his natural talents, and the quality of a scientific foresight of no mean order, that the subject of this brief sketch was enabled to achieve his position as a physicist at an age when most men are only entering upon the serious business of life. Even before he attained his majority, he had succeeded in grasping the connection between the theoretical results of electrical science at its then early stage and its latent possibilities of development, a truth which remained for many years unrecognised by his fellow-workers.

SIR WILLIAM THOMSON was born at Belfast, in 1824. From his father, Dr. James Thomson (the noted professor of mathematics in the Royal Belfast Academical Institution, and, later, in the University of Glasgow), he inherited the taste for mathematical studies, which became a marked feature in his scientific labours. The same tastes, doubtless, led him to Cambridge, where he graduated as Second Wrangler in 1845. Before entering the University, however, he had already given to the world the first of his mathematical papers, one of which, on the "The Uniform Motion of Heat in Homogeneous Solid Bodies, and its Connection with the Mathematical Theory of Electricity," was written at the age of seventeen. In 1846 (when he was but twenty-two years of age) he was elected to the Professorship of Natural Philosophy at the University of Glasgow, a position which he has since continued to hold with much distinction.

It is impossible within the limits of this notice to give even a list of the titles of the numerous valuable contributions to science which we owe to SIR W. THOMSON, or details of the many important investigations in physics and mathematics upon which, during this long course of years, he has from time to time been engaged. From his labours he may be said scarcely ever to have rested, and he has contributed to the *Transactions* of nearly all the societies of the highest standing in Great Britain. He is now bringing out a reprint of his Mathematical and Physical Papers, of which two volumes containing the papers published prior to 1856, are now published. A volume containing his papers on Electrostatics and Magnetism was published 16 years ago. He is also joint author with Prof. Tait of a Treatise on Natural Philosophy. He has been the recipient of the Royal Medal of the Royal Society of London, the

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SIR WILLIAM THOMSON, M.A., LL.D., D.C.L., F.R.S., &c.

From a Photograph by Frederick Hollyer, Kensington, London.

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Keith Prize of the Royal Society of Edinburgh, and the Hopkin's Prize of the Cambridge Philosophical Society. In 1871 he was President of the British Association at Edinburgh, and he has, besides, presided over the Mathematical Section of that body no fewer than five times, the last occasion being that of the Jubilee Meeting of the Association at York in 1881, when he took for the subject of his address, "Sources of Energy in Nature Available to Man for the Production of Mechanical Effect." In 1872 he occupied the presidential chair of the Geological Society of Glasgow; he was appointed British Commissioner for the Electric Exhibition at Vienna in 1883, and has occupied many other official positions and appointments.

Electricity, as we have seen, occupied a large share of his attention from the early days of his career. His "Bakerian Lecture," given in 1855, dealt with the "Electro-Dynamic Properties of Metals," and embraced a series of original investigations of high value, the subject being followed up by many successive contributions to our knowledge, all of which may be said to have thrown new rays of light on obscure problems of electro-dynamics. Long prior to this date, however, he had paved the way for his work in this direction by his researches into the dynamical theory of heat, to which both he and his friend Joule devoted earnest attention. His most important work in electricity—or, at any rate, that with which his memory will, in all probability, be most prominently associated—is the application of his mathematical and physical researches to the problem of submarine telegraphy. Probably no invention that the world has yet seen has so greatly revolutionised the entire methods of commerce as that of the ocean telegraph, which almost annihilates distance between continent and continent. The difficulties of signalling through a cable 2,000 miles in length at the bottom of the Atlantic were, on its early establishment, enormous, the slowness by which the transmission of signals then took place being a threatened cause of failure. THOMSON specially worked at this problem, deduced the "law of squares" (now familiar to all telegraphers), and was called in consultation with the Directors of the Atlantic Cable, when he introduced several improvements by which the long-existing obstacles in the way of rapid transmission of signals were overcome. His inventions of the mirror-galvanometer and siphon-recorder are now exclusively used on the long submarine lines. Owing to the extreme delicacy of the latter instrument it can be worked by a low battery power, adding greatly to the preservation of the cables. In these investigations into submarine telegraphy he was assisted to some extent by the late Cromwell F. Varley, and by the late Professor Fleeming Jenkin (then a young engineer of promise, engaged in superintending electric-cable expeditions and fitting out vessels at Birkenhead), with whom he worked at the laying down and repair of many deep-sea cables. Jenkin was also his colleague on the Committee on Electrical Standards. On the completion of the Atlantic cable in 1866 THOMSON received the honour of knighthood.

Two other inventions have obtained some amount of notoriety for their practical application in the art of navigation. One of these is his Sounding Machine, which enables soundings to be taken in depths up to 100 fathoms without slackening the speed of the ship. The other is his well-known Mariner's Compass, which aims at providing perfect corrections against disturbance by the ship's magnetism, temporary or permanent.

Mention has been already made of SIR WILLIAM THOMSON'S mathematical abilities. He has applied mathematics to the solution of many questions in terrestrial physics, some of which have an important bearing on geological teachings. Thus, in his essay on "The Rigidity of the Earth," he demonstrated that the earth must be about as rigid as a globe of steel of equal dimensions and weight. Such a state of rigidity answers far better the requirements of certain physical considerations than the old theory of a fluid globe, surrounded by a thin outer shell or crust. His application of mathematical processes to the question of the age of the world has hardly been so convincingly successful, but, at any rate, the merit is due to him of being the first to apply the mathematical method to the determination of the age of the earth. This is a question upon which geologists are not, and probably never will be, in accord. They have frequently been accused of making large "over-drafts on the Bank of Time;" and, looking at the length of time required for the deposition of each of the formations of the earth's crust and their subsequent denudation and re-deposition, many geologists find an insuperable difficulty in accepting the limit of 100 million years, which SIR WILLIAM THOMSON has sought to impose upon them for the duration of the period during which life has existed on the earth. The answer of the mathematician, of course, is that the geologist must "hasten his phenomena," a proceeding which, as a rule, he is little inclined to adopt.

Touching now upon the more recent labours of SIR WILLIAM THOMSON, it must suffice to refer to the valuable aid which he has given to the development of the science of electricity by the series of measuring instruments which he has from time to time brought out. His recent address to the Institution of Electrical Engineers on "Electricity, Ether, and Ponderable Matter" (of which an abstract was given in our February number) may also be referred to as one of the best expositions of a subject intensely difficult that have yet been presented. Within the last two or three years he has published, in the *Philosophical Magazine* and elsewhere, a long series of mathematical investigations bearing on wave motion, and having reference to the constitution of the ether and ponderable matter.

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In closing this brief record, we can but add that the career of SIR WILLIAM THOMSON affords an illustration of the valuable aid which the world derives from the action and re-action upon one another of scientific principles and scientific applications. The life-work of SIR WILLIAM THOMSON teaches us that the most useful and practical discoveries are based upon the assiduous cultivation of the methods of scientific reasoning. O. W. J.

Local Museums.

VI.—Warwick.

THIS Museum was commenced through the exertions of Dr. Lloyd, in 1836, and in the May of that year it was opened with a lecture, delivered by the late Professor Buckland. The collections are placed in three rooms above the Market Hall. The strong point of the Museum is now the geological collection, which is in good order, the Committee having called in the aid of Mr. E. B. Newton, F.G.S., of the British Museum, South Kensington, in classifying and arranging the specimens. There is a well-arranged series of organic remains, including most of the characteristic fossils of all the geological formations. Among local fossils, through the untiring interest of the Rev. P. B. Brodie, F.G.S., the Museum can boast of fine specimens of the Lias and New Red Sandstone. An entire specimen of *Plesiosaurus dolichodeirus*, from the Lias of Wilmcote, is considered one of the best known. There is also a fine example of the Irish Deer *(C. megaceros)*, and of Triassic fossils, consisting of remains of fish and labrinthodonts, all from the neighbourhood.

The centre of the room on the left is occupied by the small but choice collection bequeathed by the late Mr. W. Kirshaw, but it is to be regretted that, according to his will, this series must be kept separate, and has special cases devoted to it.

A large and valuable collection was also lately presented by Mrs. Charles Wise, of Shrubland Hall, Leamington. Besides these, several important additions have been made by the Venerable Archdeacon Holbeche and the Rev. P. B. Brodie, Hon. Sec.; specially to be noted is the small but very interesting collection presented by the latter, of fossils, chiefly Devonian and Lower Silurian, from quartzite pebbles in the drift from the neighbourhood of his parish at Rowington. In another part of the room will be found an illustrative collection of fossil sponges from the Upper Greensand.

There are a few foreign geological specimens, among which may be mentioned an excellent series of remains of the extinct gigantic birds of New Zealand, obtained from the late Dr. Haast in exchange.

Round the walls are placed numerous drawings of extinct animals and plants, and the restoration of many of these by the Science and Art Department are invaluable to students. It is much to be wished that the Government would allow Professor Woodward's beautiful illustrations of fossils at the South Kensington Natural History Museum to be copied and reproduced at a moderate price for the use of classes in the provinces.

In the upper room of the Museum there is a very fair and illustrative series of Minerals, lately carefully named and rearranged by Mr. F. R. Mallet, F.G.S. (superintendent of the Geological Survey of India, and in charge of Minerals in the Geological Museum at Calcutta). A classified collection of recent shells, lately rearranged by Miss F. Taylor, is to be found lining the walls of the lower left hand room. These have been the gifts of various donors, and nearly each marine type is represented; to which has been added a very useful series of land and fresh water Mollusca, collected, named and presented by Miss Baly, including local species. In Botany, the society possesses a large herbarium of rare and local plants, most of which were secured by the purchase of Mr. Perry's collection. The Midland Counties present an almost unworked entomological field, but the collection already belonging to the Museum is in course of arrangement, and the Aculeate Hymenoptera, occupying nine drawers, are already arranged. In the lecture room are many local specimens of birds, besides other representatives of ornithology. Leading from this room is the Library, which contains works of reference upon most branches of science.

Meetings are annually held in the Museum of the Warwickshire Field Club.

Through a falling off in the number subscribers the committee are in need of funds to provide for the proper display of many valuable collections of specimens, and also for a continuance of the popular lectures, which, some years ago, were a great source of attraction.

The Museum is open daily (except on Sundays) to members of the Warwickshire Natural History and Archæological Society, and on one day of the week, free, to local inhabitants. The building closes at 5 o'clock in summer and at 4 in the winter. The ordinary charge for admission is 6d.

Societies.

THE INSTITUTION OF NAVAL ARCHITECTS.—The proceedings in connection with the annual gathering of this institution were resumed on 11th April, when Sir Nathaniel Barnaby read a paper on "The Protection of Buoyancy and Stability in Ships." In the course of this paper, Sir Nathaniel dwelt on the increased use of armour arising out of the introduction of the high-explosive shell and the rapid-firing gun. He had been studying the altered conditions thus brought about, and he now exhibited the design of a ship 3,200 tons, prepared by the Naval Construction and Armaments Company, at Barrow, under his advice. Its peculiar characteristic consisted in the use of a packing material, constituting a species of wood-armour, distributed along the water line and elsewhere, as a substitute for armour of iron or steel. The amount of this new material used in the Barrow design was between four and five per cent. of the displacement. It was 18 inches deep in the shallowest place, and six feet deep at the sides. The cost of the packing was £6,000 for the ship. One advantage possessed by this material, which side armour had not, was that it could be applied to all fighting ships, whether large or small. A solid raft, formed upon and above a deck covering the machinery and magazines, and occupying the water zone, represented what was wanted in every fighting ship, and was part of this design. Sir Nathaniel Barnaby hoped that this method of protection would come into use, because it would provide reasonable security against foundering, under artillery fire, to all ships of war. It would allow of some armour being applied to protect the batteries against the attack of the high-explosive shell and the quick-firing gun. The present defencelessness of the batteries was no longer tolerable. The unprotected state of the smaller ships was dwelt upon as being peculiarly disadvantageous. We were told, on the highest naval authority, that the heavy-armoured ships would be accompanied on all occasions by a considerable number of the unarmoured, the latter for the purpose of flanking and supporting the heavy ships against attacks which would be perilous to them. Thus, the unarmoured ships would have to give and receive blows, and would be exposed to peculiar danger. Against this state of things Sir Nathaniel Barnaby protested. By the method now proposed this could be remedied. There would be a large increase in the number of ships, and in the power of putting fighting men afloat. For a million or a million and a quarter of money they might have five ships instead of one, with a total displacement of 16,000 tons as against 14,000, the speed in each case being 17 knots, and the number of men from 500 to 600. It was claimed for a ship constructed according to this plan that it fulfilled the recommendation

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of the committee on designs which sat in 1871, which committee directed attention to the desirability of getting a reserve of buoyancy by other means than armour plating.

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CLYDESDALE NATURALISTS' SOCIETY.—The ordinary monthly meeting was held on Wednesday evening, 17th April, in the Society's rooms, 207, Bath Street, Mr. T. J. Henderson in the chair. Mr. J. Macnaught Campbell exhibited rare abnormal specimens of various species of starfish, including the Common Crossfish, *Uraster rubens*, Linn., from South Wales, and the Singthorn, *Luidia fragilissima*, Forbes, from Cornwall, some of which showed the power which these animals possess of reproducing limbs which they have lost through accident. Of the latter species, one was exhibited having six rays, the normal number being five, and being of extremely rare occurrence. Mr. Campbell also exhibited eggs ot *Bulimus oblongus*, a West Indian land shell, which had a calcareous shell, and were about as large as the egg of the house sparrow. Mr. Robert Dunlop exhibited specimens of Fossil Parraffin from Airdrie, and Mr. D. C. Glen, F.G.S., specimens of allied substances, known variously as Ozokerit, Elaterite, Mineral, Caoutchouc, &c. Mr. Dunlop also exhibited specimens of a moth not previously recorded for Scotland, *Dasypolia templi*, and which had been taken in March last, under slabs of shale, near Airdrie. Mr. George E. Paterson exhibited a large series of specimens of the Heron, including the Common Heron, *Ardea cinerea;* the Purple Heron, *A. purpurea;* and the Night Heron, *Nycticorax Gardeni*, also of the allied species, the Common Bittern, *Botaurus stellaris;* and the Little Bittern, *B. minutus*, and read an interesting account of their habits and their occurrence in Scotland. Mr. Robert H. Read, of Cathcart, read a paper on "The Great Auk in Britain." He remarked that the earliest intelligent description we have of the Great Auk or Garefowl is that given by Martin in his *Voyage to St. Kilda*, published in 1698, where he says:—"The sea fowls are first gairfowl, being the stateliest, as well as the largest, of all the fowls here, and above the size of a solan goose. He stands stately, his whole body erected; his wings short, he flyeth not at all; lays his eggs upon the bare rock, which, if taken away, he lays no more for that year." In 1813 Bullock chased one of these birds, off the Orkneys, for several hours in a six-oared boat, but in vain. It was, however, killed by some fishermen soon after he left, and sent on to him. This specimen is now in the British Museum, having been purchased at Bullock's sale for £15 5s. 6d. The last Garefowl taken on St. Kilda was obtained in 1821, and was presented to the late Robert Stephenson when visiting the Hebrides in the Lighthouse Commissioners' yacht. It was allowed to sport in the water tethered by a cord attached to its leg, but one day, when off Pladda, to the south of Arran, it broke from its cord, and was seen no more. The last two specimens captured in the British Isles were taken in a landing net in Waterford Harbour in 1834, one of them being now in the British Museum. Remains of the Great Auk have been found in a kitchen midden in Caithness, in a shell mound on the island of Oronsay, and near Marsden Rocks, in Durham. This bird once roamed in countless numbers on the coasts of Newfoundland, Greenland, and Iceland, and was killed by thousands for the sake of its feathers and flesh. In fact, the fishing vessels used to take but very little provision with them, and to rely almost entirely on the supply of Great Auks or "Penguins," as they were there called, for their food. Iceland seems to have been its last stronghold, and it there existed on the rocky islets off the south-western coast in gradually diminishing numbers down to the year 1844, when the last surviving pair were killed, and the Garefowl became an extinct bird. The number of existing skins of the Great Auk is 78, and of eggs 68. Of these Britain possesses 22 skins and 45 eggs. Of the latter Lord Lilford possesses five, Mr. Rowley, of Brighton, six, while Mr. Champley, of Scarborough, is the fortunate possessor of no less than nine! The last two birds killed were sold in 1844 for £9. Mr. Hancock, of Newcastle, bought a skin and egg the same year for £10. Mr. Hewitson in 1856 says he thought the price (£5) paid by his friend, Mr. Wilmot, for an egg a few years before, very extravagant, "little dreaming we should live to see the day when six times as much would be paid for one." In 1880 Mr. Small, of Edinburgh, bought a couple of eggs at an auction for 32s. He sent them to London, where they were again sold by auction at Stevens's, and were bought by Lord Lilford for £100 and 105 guineas respectively! In December, 1887, an egg was sold at Stevens's for £168, and in 1888 another fine specimen was knocked down for £225 to a London dealer in natural history objects. In illustration of his paper Mr. Read exhibited a large series of models of eggs of the Great Auk, made to scale and carefully coloured by himself after existing specimens. After the usual vote of thanks the society adjourned to the evening of Wednesday, 15th May.

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LIVERPOOL MARINE BIOLOGICAL COMMITTEE.—Through the kind permission of the Liverpool Salvage Association, the "Hyæna" was again placed at the disposal of the Liverpool Marine Biological Committee for the Easter holidays, and a large number of biologists took advantage of the opportunity for traversing a portion of the district to the west of the Isle of Man, hitherto but little explored. Professor Herdman, of Liverpool University College, as usual, took command of the expedition, and amongst the others were Dr. Larkin, Dr. Hanitsch, Messrs. N. Caine, W. S. McMillan, F.L.S., I. C. Thompson, F.L.S., W. R. Melly, A. Leicester, A. T. Watson (Sheffield), Wilkins (Uttoxeter), T. Shepheard (Chester), Christian, Clubb, and Lomas. Captain Young accompanied the expedition on behalf of the Salvage Association. On Good Friday morning the "Hyæna" left Port Erin at an early hour and proceeded to sea for a distance of ten miles, and dredging was at once commenced at a depth of about fifty fathoms. It had been the intention to proceed further, where a depth of eighty fathoms is reached, but the extreme roughness of the sea rendered dredging operations almost impossible, and, after a few hauls, the "Hyæna" was obliged to return to Port Erin. The rare star-fish, *Palmipes membranaceus*, and specimens of the common star-fish, *Asterias Rubens*, but measuring a length of fifteen inches from tip to tip of the rays, and a large number of *Echinus esculenta* and *Spatangus purpurcum* were amongst the captures. The deep-sea tow nets were worked by Mr. McMillan, simultaneously with the surface tow-nets, by Mr. Thompson, and a large number of microscopical crustaceans were taken, the results of which can only be worked out in the laboratory. The prevalence of larval forms was very noticeable. The continued roughness of the sea during the day rendered any considerable further dredging attempts futile beyond the harbour. A party proceeded over the southern corner of the Isle of Man to examine the remarkable natural caverns and chasms, of which a large number are found there. Shore collecting was carried on by many of the party at Port Soderick, and again at Fleshwick Bay, during the evening, when a number of valuable specimens were obtained from the tidal pools, including polyzoa, copepoda, sponges, &c. Several specimens of the Alga *Codium tormentosum* were found in the Fleshwick pools with the nudibranch *Elysia viridis* living on it. The beautiful shell mollusc *Helcion pellucidum* was also found The next morning, the weather still rendering it inexpedient to proceed to sea, the novel expedient was adopted of floating life-buoys, with tow-nets attached from the "Hyæna," to a long distance in the harbour. One of the most interesting points in the expedition was the use of the electric light as a means of attracting the life of the lower depths. For this purpose electric lights were lowered near the orifice of the tow-nets, on each side of the vessel, as soon as it became dark, to a depth of thirty feet, while, at the same time, electric lights were displayed from the deck of the vessel, brilliantly illuminating the surface of the water. On bringing up

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the deep tow-nets a large number of the rarer microscopical crustacea the cumeacea were found, as well as a large number of amphipoda, sagitta, and copepoda. The cumeacea are rarely, or never, found at the surface of the water, and it is, therefore, interesting to note that on examining the contents of the surface tow-nets during the display of the electric light a large number of these animals had found their way from the bottom to the surface, doubtless attracted by the light. Further dredging was resumed, as soon as the weather moderated, towards the direction of the Calf of Man, and some very good results were obtained. The return journey was made direct from Port Erin to Liverpool, the "Hyæna" stopping at intervals when dredging and tow-netting were carried on. An interesting feature of the expedition was the demonstration of Mr. W. E. Hoyle's new deep sea tow net, which, by a skilful arrangement of messengers, can be opened or closed at will at any required depth.

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LIVERPOOL BIOLOGICAL SOCIETY.—The seventh ordinary meeting of the Biological Society was held at University College, on Friday, the 12th of April, 1889, Dr. Drysdale, vice-president, in the chair. Mr. A. O. Walker, F.L.S., of Chester, read an interesting paper on "The Habits of Certain Terrestrial *Isopoda*, which are Occasionally Found in Marine Pools." Professor Banks read a paper on "Some Varieties of the Thoracic Aorta," and by means of diagrams and models demonstrated the various forms which the thoracic arch assumes in birds, reptiles, and mammals, showing the occasional tendency to reversion to original types. Dr. Ellis read a paper upon "The Unusual Abundance in 1888 of the Madder-Hawk Moth." Mr. J. Lomas read the second report on the "Polyzoa of the Liverpool Marine Biological Committee's District," which showed that 109 species had already been found. [The paper by Dr. Ellis is in type and will appear next month.]

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LIVERPOOL NATURALISTS' FIELD CLUB.—At the meeting held on Friday, April 12th, Mr. G. H. Morton, F.G.S., exhibited and explained a portion of a large series of Geological and Natural History diagrams. Although only 12 by 18 inches in size they were remarkable for their distinctness and the information they conveyed. The subjects illustrated were faults, mineral veins, sections of coal strata, restorations of extinct mammalia, reptilia, and other fossils. The diagrams were evidently valuable records of many geological observations in a convenient and novel form. A cordial vote of thanks was passed to Mr. Morton for his instructive lecture.

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LANCASHIRE AND CHESHIRE ENTOMOLOGICAL SOCIETY.—The monthly meeting of this society was held on 1st April, the president (Mr. S. J. Capper, F.L.S.) in the chair. Mr. R. Wilding, honorary secretary, read "Notes on Coleoptera Taken During 1888," in the course of which he gave an interesting account of pleasant hours spent among the insect inhabitants of the ponds and ditches, particularly in the neighbourhoods of Leasowe, Moreton, and Liscard. He also mentioned the capture of many rare and local species in the salt marshes on the Cheshire side of the river Dee, remarking that since this locality had a distinct flora of its own it would of necessity follow that the insect fauna would be peculiar and distinct from that of the surrounding country. The Rev. S. Gasking said he quite agreed with the reader of the paper. Pond work was indeed most interesting, as he had found from practical experience. He had visited the Puddington salt marshes botanising, and felt quite certain that when thoroughly searched they would produce something new to the insect fauna of Britain. Messrs. C. H. H. Walker and F. N. Pierce exhibited through the micro-lantern, and made remarks on a number of beautifully-prepared microscopical slides showing the heads of various insects. During the *conversazione* the members had the pleasure of inspecting a very fine selection of European lepidoptera from the "Cook" collection, lent from the Museum by the kindness of Mr. Moore.

THE YORKSHIRE COLLEGE SOCIETY OF CHEMISTS AND COLOURISTS.—A meeting of the above society was held in the Dyeing Department, on Thursday, March 28th, Mr. H. Hastings in the chair, when Mr. Duncan read a paper on the "History of the Atomic Theory," before a large attendance. The lecturer, in the course of his remarks, said that the atomic theory is as held by the ancient Greeks, and showed how this was revived at the begining of this century to explain two laws of chemical combination. An account of how the laws were established and how they were interpreted by the atomic hypothesis was then given. He then explained how the distinction between two kinds of ultimate particles—molecules and atoms—was introduced into the science, and gave the reasons for supposing that the molecule usually consists of two atoms. Some of the methods used for determining atomic weights were then mentioned, reference being made to vapour density, specific heat, and isomorphism. He next pointed out that the numbers so obtained were only relative, and gave an account of some of the ways that have been employed for measuring the absolute size and weight of the molecules. Arriving at inconceivably small numbers, for example, the diameter of a molecule of chlorine was shown to be ·96 millionth of a millemetre, that of water ·44, and it would take 144 trillion molecules of hydrogen to weigh 1 milligram. He showed that these numbers agreed with many known facts. In conclusion he mentioned the "vortex atom theory," and showed how this explained the possibility of having an ideal atom.——At a meeting on April 11th, Mr. G. W. Alvey Teanby gave a short account of a very interesting research made upon nickel and cobalt, in the laboratory of Munich University, by Dr. Krüss and Heir Schmidt. These chemists, in a recent attempt to re-determine the atomic weights of these elements, obtained such fluctuating results that it became necessary to seek for the disturbing cause. Great interest was aroused when it was found that the filtrates from the same stage of the process in both determinations exhibited peculiarities which were in each case precisely similar. These were, therefore, collected separately and carefully examined. On evaporation and ignition in a platinum dish a white residue was obtained, which dissolved in hot strong hydrochloric acid, with a peculiar green colour, and in this solution neither nickel nor cobalt, nor any other known element, could be detected, and it was at last accounted to be the chloride of one and the same body, a possibly new element. When perfectly dry and free from excess of acid this chloride is white, and forms a colourless solution in water. If treated with vapour of hydrochloric acid the white chloride turns green, and then yields a green solution with water. The acid solution of the chloride is not precipitated by sulphuretted hydrogen; but from its neutral solution ammonium sulphide throws down a brown-black sulphide, which is soluble in acids. Ammonia and caustic potash precipitate the hydrate from the neutral chloride solution in voluminous white flakes, resembling the hydrates of zinc and aluminium; in each case, however, the precipitate is insoluble in excess of the alkali. By strongly igniting the hydrate, the oxide is obtained as a fine white powder, which dissolves easily in cold dilute hydrochloric acid; if dissolved in strong acid the solution displays the peculiar greenish colour previously mentioned. The oxide behaves very differently in a current of hydrogen to nickel and cobalt, since even at the strongest heat it suffers no loss of weight. When ignited with charcoal the oxide is reduced, and a brownish-black, malleable, metallic powder is obtained, and this same substance is also produced by electrolysis of the aqueous solution of the chloride, and also by reducing the chloride at a red heat in a current of hydrogen. It is worthy of remark that the metallic powder which has been strongly heated is much less readily soluble in acids than that which is obtained at a much lower temperature by electrolysis, a fact which would seem to indicate the existence of allotropic modifications. As a result of this research, Dr. Krüss finds that this new body is present in both nickel and cobalt to the extent of

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2 to 3 per cent. When it is eliminated nickel or cobalt, as the case may be, still remain, but with modified properties; thus, he says, the salts of pure cobalt are violet in colour, and those of pure nickel very dark green. So far, the authors have disclosed only portions of their researches, and it will be interesting to know the result of their further work, and especially of determinations of a physical nature, such as those of vapour density and specific heat.

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GEOLOGICAL SOCIETY OF LONDON.—At the meeting on 20th March, the following papers were read:—(1) "Supplementary Note to a Paper on the Rocks of the Atlantic Coast of Canada," by Sir J. W. Dawson, F.R.S. The author formerly referred to the *Olenellus* fauna as characterising the Middle Cambrian. This fauna he had now no doubt was characteristic of the upper member of the Lower Cambrian. He concluded that the Lower Cambrian was, in America, a period of continental depression, and the Middle Cambrian a period of continental elevation. (2) "The Occurrence of Colloid Silica in the Lower Chalk of Berkshire and Wiltshire," by W. Hill, F.G.S., and A. J. Jukes Browne, F.G.S. The globula colloid silica was shown to be directly derived from the remains of siliceous sponges. (3) "Notes on the Pelvis of *Ornithopsis*," by Professor H. G. Seeley, F.R.S. The author described the remains preserved in Mr. Leed's collection at Eyebury, comprising the largest and most perfect pelvic bones of a Sauriskian known in this country. The type of pelvis had not previously been observed.——At the meeting on 3rd April, the president (Mr. W. T. Blandford) announced that the Société Geologique de France proposed to hold its extraordinary meeting this year at Paris, on 18th August. Mr. R. N. Worth read a paper on "The Elvans and Volcanic Rocks of Dartmoor," in which the granite of Dartmoor was shown to pass upwards into felsitic and volcanic rocks, remnants of which are to be found in the Triassic conglomerate of Devon. Papers were also read by Mr. F. A. Bather on "The Basals of Eugeniacrinidæ," and by Mr. E. A. Walford on "Some Polyzoa from the Inferior Oolite of Shipton Gorge, Dorset."

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CHESTER SOCIETY OF NATURAL SCIENCE.—At a meeting of the Geological Section of this society, held at the Grosvenor Museum, on 21st March, a paper was read by Mr. Osmund W. Jeffs, of the Liverpool Geological Society, entitled "The Volcanoes of Southern Italy: with a Note on the Latest Theory of Volcanic Action." The chair was taken by Mr. William Shone, F.G.S. Mr. Jeffs stated that the past year (1888) had been marked by a comparative quiescence of volcanic activity in the world. It was not to be inferred from this, however, that a cessation had taken place in the action of those powerful forces which are in operation in that vast laboratory of nature existing beneath our feet. Minor eruptions were reported from the New Hebrides, America, and the Pacific; and in Europe, in the month of July last, a great eruption took place at Vulcano, one of the Lipari Islands. The immunity which we in England enjoy from earthquake shocks of great violence, and from volcanic eruptions, was, geologically speaking, of recent date; and in the hot springs which still rise from the depths of British strata are veritable links in the chain of evidence of volcanic history of the British Islands. At Bath, hot springs, rising at a temperature of from 104 to 120 degrees, still issue from the valley and fill the actual wells built centuries ago by Roman masons, whose admirable work has fortunately been rescued from oblivion, and now, opened out to the light of day, forms one of the finest historical monuments of the Roman period existing in our country. A view thrown on the sheet of the ancient hot bath of *Aquæ Solis* afforded an opportunity of comparison with Roman work at Chester. The first part of the paper was chiefly occupied by a description of a series of photographs, illustrating the craters and lava streams of Vesuvius, Stromboli, Etna, and Vulcano. These views were taken last year (shortly before the recent eruption of Vulcano) by Dr. Tempest Anderson, of York, and were shown by him at the meeting of the British Association at Bath last September. Amongst these were instantaneous pictures of the craters of Vesuvius and Vulcano during eruption, showing very vividly the discharge of steam and showering of ashes, which usually takes place. The ruined temple of Serapis, with its columns, made famous by the observations of Sir Charles Lyell, and described in his classical work, *The Principles of Geology*, was also shown. After conducting his audience through an imaginary tour in Southern Italy, and the less known region of the Lipari Islands, Mr. Jeffs devoted the remainder of his paper to a brief discussion on the main elements of volcanic action, which were rendered as twofold:—(1) The existence of a high temperature at certain points within the earth's crust; and (2) the presence of quantities of water and gas imprisoned in the rocks. Proofs of the former were to be seen in the molten condition of the matter issuing from volcanoes, and of the latter in the vast quantities of steam and gases thrown out during an eruption. The condition of the earth's interior has long been a problem. Man has always felt a desire to know what was in the centre of the earth, and volcanoes were one means of gaining an insight into the hidden regions below the surface of the globe. The old idea, so long held, that we are dwelling upon a thin stratum, or crust, covering an enormous well of molten matter, was hardly supported by recent researches of geologists and physicists. The idea is gradually gaining ground that volcanic action is not due to the existence of a universal reservoir of incandescent matter, but to the local development of heat at moderate depths from the surface, and in places of the crust independent from one another. Mr. Mellard Reade has lately given to the world one of those original and striking theories with which the most progressive of the physical science is enriched from time to time. In his "Origin of Mountain Ranges," Mr. Reade has called attention to the intimate connection existing between volcanic action and mountain-building. All mountain ranges have once been areas of sedimentation, and in all ranges volcanic orifices have been broken through old denuded rocks. According to his theory the deep-seated rocks are regarded as practically solid, through pressure, although hot; but this material, if at the surface, where the pressure would be less, would assume a form nearly liquid or flowing, a condition known as "potentially-molten." The rocks become heated by continued deposits over them, water is imprisoned in them, and steam is generated, which is the sole essential phenomenon of volcanoes. The contraction of the rocks after expansion causes the production of fissures, through which water penetrates, and an explosion ensues. The welling-out of lava in a molten state is caused by the expanded matter finding a relief through suitable vents or lines of weakness in the crust of the earth. Mr. Logan Lobley has recently arrived at a similar conclusion. Hitherto the *cubical* expansion of rocks under a rise of isogeotherms has been overlooked, until pointed out by Mr. Reade. The movement of rock masses caused by this expansion results in the phenomena which are found to accompany the formation of great mountain ranges and the eruption of volcanic matter in all parts of the globe. The chemical theory so ably advocated by Professor Prestwich need not be altogether discarded, but the effects of this action were regarded as of secondary consequence. Mr. Jeffs, in conclusion, maintained that many physical causes operated in producing volcanic action. The relation between one set of volcanic phenomena and another, and the origin of those great movements which have been recorded throughout all the geologic ages, have long been mysteries, requiring the most devoted study of the physics of the earth's crust to afford us even a glimpse of their solution. In the course of the discussion which followed, Mr. Shone called attention to the universal presence of steam in eruptions, and said it was remarkable that the use of so powerful an agent was not earlier discovered. Dr. Stolterfoth also made some interesting remarks relative to extinct volcanoes, and expressed his agreement with the view that the interior of the earth was solid, though at a great heat.

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HULL GEOLOGICAL SOCIETY.—The first annual meeting of this society was held on Thursday evening, March 28th, at the Royal Institution, Hull, Dr. F. F. Walton, F.G.S., in the chair. The secretary, Mr. J. W. Stather, in his report congratulated the members on the success which had attended the operations of the society during this its first year, the membership being now upwards of fifty. Both the field excursions in the summer and the winter lectures were well attended, and the financial statement showed a satisfactory balance in hand. Several important gifts to the library were announced from W. H. Huddleston, Esq., M.A., F.R.S , F.G.S., and J. W. Lamplough, Esq., of Bridlington. The officers for the ensuing year are as follow:—President, Dr. F. F. Walton, F.G.S.; vice-presidents, Mr. Fras. Bond, M.A., F.G.S., Rev. E. M. Cob, M.A., F.G.S., Dr. Thos. Walton, and Mr. W. Hunt; secretary, Mr. J. W. Stather; treasurer, Mr. W. Dixon; committee, Messrs. M. Carmichael, Jas. Carter, C. E. Des Forge, J. F. Robinson, Geo. Silaton and J. Stears. An attractive syllabus of field excursions has been arranged as follows:—April 6th, Duffield (Mr. J. R. Mortimer's museum); Easter Monday, Brough and District, with the Leeds Geological Society; May 25th, Burton Cliff; Juue 10th, Yorkshire Wolds (Burdale); Whit-Monday, June 21st, Robin Hood's Bay, with the Yorkshire Naturalists' Union; July 6th, Withernsea, for Dimlington; August Bank Holiday, Cottingham, for Skidly and Beverley; Sept. 4th, Kirkham Abbey and Acklam Brow, with Yorkshire Naturalists' Union; and Sept. 14th, South Cave.

LIVERPOOL GEOLOGICAL SOCIETY.—At the last evening meeting of this society for the session 1888-9, held on April 9th, a paper was read by Mr. G. H. Morton, F.G.S., on "Some Faults Exposed in Shafts and Borings in the Country Around Liverpool." Mr. E. Dickson, F.G.S., and Mr. P. Holland, F.C.S., read a joint paper on the "Examination of Some Volcanic Rocks from the Isle of Man," the specimens having been obtained from the numerous dykes in the south of the island on the occasion of an excursion by the society to that district, at Whitsuntide, 1888. The rocks exposed on the south coast are Silurian (or Cambrian) slates, beds of carboniferous limestone, with interbedded volcanic rocks, a coarse quartzose conglomerate, now considered as forming the base of the carboniferous system, and the boulder clay. The volcanic dykes fall into two series, viz.:—(1) Felsitic dykes which traverse the Silurian, but not the more recent formations; and (2) Basaltic dykes, which traverse both the Silurian and carboniferous beds, including the agglomerate or ash, between Scarlett Point and Poolrush. While traversing the limestone and slate the basaltic dykes are unbranched, but when traversing the conglomerate on the west of Langness the dykes are frequently branched. All the dykes have a general E. and W., or N.E. and S.W. direction. The paper described in some detail the results of examination of the rocks in the case of a felsitic dyke traversing the slate at Crosby Quarry, St. Johns. No trace of contact metamorphism was apparent at the junction, but analysis showed that the slate in proximity to the dyke, compared with the same rock at a considerable distance, contained 8 per cent. less silica and 2 per cent. less water. A specimen of rock from the summit of the Stack of Scarlett was found to be composed of labradorite, pyroxene, magnetite, and ilmenite, and was regarded as intermediate between basalt and andesite, and its chemical analysis showed the presence of 46·7 per cent. silica, 1·94 titanic acid, 6·24 of oxide of manganese, and 5·88 of combined water. The gabbro from the quarry at Rock Mount was also examined, and found to consist of labradorite, serpentine, ilmenite, magnetite, and calcite, but no diallage was observed, and its analysis showed 47 per cent. of silica and 13 per cent. of oxide of manganese.

LIVERPOOL GEOLOGICAL ASSOCIATION.—A meeting was held on 1st April in the Free Library, William Brown Street, the president, Mr. A. Norman Tate, F.I.C., F.G.S., in the chair. The secretary (Mr. I. E. George) announced several donations. Mr. James Wilding, instructor in masonry in the Liverpool School of Science and Technology, read an interesting paper on "The Building Stones used in Liverpool," in which he spoke of the stones obtained from different geological formations. He mentioned the buildings in which they were employed, and the peculiarities of colour, &c., suitable for different kinds of work, and referred to their capabilities of withstanding weathering influences. He also spoke from an architectural view not very favourably on terra-cotta. As a contribution to economic geology the paper was very valuable, and at its conclusion a discussion took place, in which the Rev. S. Gasking and Messrs. I. E. George, Hornell, Samuel Davies, and Dale and the president took part, the comments made being mostly favourable to the opinion of the lecturer. A hearty vote of thanks was accorded to Mr Wilding.——Under the guidance of the Rev. S. Gasking, B.A., F.G.S., a party of this association took advantage of the Easter holidays to pay a four days' visit to the Isle of Man, Castletown being the head-quarters. In noting the features along the coast from Langness to Bradda Head, excellent work was accomplished, and many drawings and diagrams now enrich the members' sketch-books. To the study of the never-ending variety in the outline of sea cliff and winding headland, produced by the activity of the waves, had to be added that of the subtler markings, indicating ice action. The latter are very plainly to be seen at Scarlett Quarry, and, judging from the direction taken by the fine scratches on the limestone rocks there, the ice mass must have moved from North-East to South-West, across Derby Haven and Castletown Bay. On the shores of Poolvash Bay, hammer and chisel were busy disinterring the fossils which are so abundant in the limestones, the only drawback to this pleasurable occupation being the increasing weight of the collecting bags. Some work in the volcanic rocks of Scarlett Point was inevitable, and great was the interest taken in the unravelling of the wonderful structure of this district, with its lava streams, dykes, and other evidences of former volcanic activity. The party returned home on Monday evening well pleased with the results of their trip On Easter Monday a second contingent of the association visited Beeston Castle and the Peckforton Hills, a bold series of new red sandstone crags showing in most impressive form, the sculpturing effects of those forces which go under the general heading of "weather," when acting for untold ages upon elevated masses of rock of unequal hardness.

GEOLOGICAL SOCIETY OF GLASGOW.—The seventh ordinary meeting of the thirty-first session was held in the society's rooms, 207, Bath Street, on Thursday evening, 11th April, Mr. Daniel M'Millan, vice-president, in the chair. Mr. Robert Kidston, F.G.S., Stirling, was elected a corresponding member of the society. Messrs. D. C. Glen, F.G.S , and John Young, F.G.S , exhibited specimens and a microscopic section of a highly altered and decomposed white dolerite, intrusive in sandstone of millstone grit age, at Garngad, north-east of Glasgow. They explained the conditions under which the dolerite occurred in connection with the surrounding rock, which along the line of contact is seen to have been burnt and ndurated by heat and pressure. A thin seam of impure coal also shows considerable alteration. The white dolerite, which is called by the workmen, on account of its colour, "the pipe-clay bed," although much decomposed when sectioned, still distinctly shows its original highly-crys alline structure. Mr. John Young also exhibited a small slab of sandstone from Giffnock flagstone quarry, near Pollokshaws, the surface of which, in an area of nine square inches, showed distinctly some twenty pairs of vertical burrows of a soft-bodied marine worm, these burrows being now termed *arenicolites*, from their supposed resemblance to those of the recent log-worm, *arenicola*, of our present seas. He also referred to the great apparent abundance of the group of soft-bodied ringed worms in

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the earlier arenaceous strata of the various fossiliferous formations, in the seas of which they seem to have swarmed, some inhabiting a single burrow in the sand, while others, like these now exhibited, had two, but connected beneath. Mr. Robert Dunlop exhibited specimens of fossil paraffin from Airdrie, where it is rarely found. It appears to be a product of distillation from oil-bearing strata at a time when they were exposed to heat from intrusive igneous rocks. A miner's opinion of it was pithily expressed when he said he thought "it was some of the 'creesh' left about the time of the Flood." Specimens from Linlithgowshire were also exhibited by Mr. Joseph Somerville, V.P. Mr. John Howat showed two fine examples of hæmatite from Cumberland, one allied with crystalline barytes. Mr. J. B. Murdoch, hon. secretary, exhibited a portrait of the Norwegian explorer, Dr. Frithiof Nansen, who with five companions had crossed Greenland last autumn, and gave some interesting details of his adventurous journey across the island, remarking that, as Greenland was now in the grasp of a glacial epoch, presumably similar to that which had once held our own country in its icy embrace, Dr. Nansen's observations would be awaited by geologists with the keenest interest. From the fact that the party had been unable to catch the last steamer for the season, and had therefore to winter in Greenland, only meagre details of their journey had as yet reached this country. Mr. Murdoch then read, on behalf of Mr. W. J. Millar, C.E., some interesting notes on the geological features observed in the excavations for a reservoir for the new Bowling Waterworks. When the boulder clay had been removed, splendidly glaciated rock surfaces had been exposed, and the striæ showed that the moving ice had been forced straight up against the rock, which lay at an angle of not less than 50 degrees. A hearty vote of thanks was passed to Mr. Millar for his paper, and to the other contributors.

Manchester Geological Society.—A meeting of this society was held on 8th April, at the rooms of the Literary and Philosophical Society, George Street, Mr. John Knowles, president, in the chair. Mr. Mark Stirrup, one of the honorary secretaries, read a communication from Mr. Charles Roeder, of Owens College, on the deposit at Barton, in which a pre-historic canoe was recently found. Mr. Roeder went on to say that perhaps he might be allowed to add a word and a plea for the valuable finds in the Ship Canal excavations. Unfortunately Manchester was deprived of the blessing of an archæological museum; that was a place specially and essentially devoted to the preservation of historical and pre-historical relics and monuments. In this regard it was behind other towns, much to one's grief. The consequence was that many articles of the greatest archæological value became lost, scattered, or were taken elsewhere. Mr. William Watts, F.G.S., of the Rochdale Waterworks, Piethorne, sent a paper on the use of roburite and other explosives in mines. He has had some experience of the use of roburite, and bore out the statements made at the previous meeting of the society as to the deleterious effects of the fumes from this substance. Mr. Herbert Bolton also contributed some notes, which were read in his absence by Mr. Stirrup, on fish remains from the lower coal measures of Rossendale. He said the remains laid on the table were got from a bed of black shale, fifty-six feet in thickness, which overlies the Upper Foot or Bullion Mine of the Rossendale area. Running through the shale bed were numerous layers of ironstone, nodules, and solitary ones also occurred. It is from the latter that the specimens were obtained. So far as was known no fish remains had been previously recorded from this particular stratum in Rossendale, though fish scales and teeth were fairly abundant a little higher in the shales which rest upon the mountain mine.

Greysouthen Reading Room.—On Thursday evening, April 18th, Mr. S. Duff, schoolmaster, gave an interesting lecture on "Coal," in the Greysouthen Reading Room. The lecture was fairly well attended. Mr. Duff explained the formation of coal, and illustrated his lecture by fosssils, which were passed round and inspected by the audience. A very pleasant hour was brought to a close by a vote of thanks to the lecturer.

Manchester Microscopical Society.—At a meeting held on April 4th, Mr. H. G. Willis, M.A., read a paper on the "Pollination of Flowers," in the course of which he said:—By pollination is meant the process by which pollen is transferred from the anther to the stigma; if the pollen is deposited on a stigma in its own flower, that flower is said to be self fertilised; if on a stigma of a different flower, cross-fertilised. For eleven years Darwin carried on numerous experiments on many kinds of flowers, and in all cases the numbers and weights of the seeds, and heights of the seedlings from cross-fertilised flowers, were far superior to those from self-fertilised. He stated at first that "nature abhors continual self-fertilisation," and subsequently that even for those plants which are habitually self-fertilised an occasional cross is beneficial. Some flowers, as the violet and wood-sorrel, which are only very rarely cross-fertilised, bear later in the year another sort of flower which never opens, has very small, spurless petals, and fertilises itself. The pollen, while still in the anther and unstimulated by contact with the stigma, emits its tubes, which reach the adjacent stigma. Flowers are cross-fertilised by means of either the wind or insects and birds. Wind-fertilised flowers are characterised by the smallness or absence of petals, by dry and smooth pollen produced in large quantities, and a feathery stigma. Many, as the hazel, alder, and ash, blossom before the leaves are out, so that the pollen is blown about more freely. Insect-fertilised flowers possess large and conspicuous petals to attract insects, sticky and rough pollen to adhere to their bodies, pollen in small quantities and small stigmas, as the pollen is conveyed with certainty. Many small flowers grow side by side to make a conspicuous mass, as the hogweed, the beaked-parsley, the daisy, the dandelion, &c. In some, as the knapweeds and Guelder rose, the outer flowers are large and barren, and serve solely as advertisements of the honey in the inner flowers, the honey being the pay the insects receive for carrying pollen. The scent is another means of attracting insects; many white or pale yellow flowers are scented, and emit their perfume chiefly at night, thus attracting the nocturnal insects. The means by which self-fertilisation is prevented and cross-fertilisation effected are numerous and wonderful. With many flowers pollen from another plant, or even species, has far more effect than its own. In some cases the anthers and pistils are borne in different flowers, or even on different plants, as in the hazel and other catkin-bearers, the nettle, the campion, &c. In a third and very large class the stamens and pistils mature at different times. An interesting series is formed by four geraniums, *pratense*, *pyrenaicum*, *molle*, and *pusillum*, in which a diminution in the size of the petals is accompanied by a diminution in the intervals between the times of maturing of stamens and stigmas, and consequently in the power of effecting cross-fertilisation. The foxglove and arum are flowers of this class which are particularly worthy of attention. A fourth class takes in plants bearing two forms of flowers, the stalks of the stamens and stigmas being of such lengths that pollen from one form will be carried to the stigma of another form. Such are the primrose, with two forms, and the purple loosestrife, with three forms. In the pea, the violet, and the green-winged orchis the structure of the flower is wonderfully adapted for crossing. For explaining the marvellous mimicry of the fly (and bee) orchis the startling theory (founded on a single observation of the lecturer) is advanced that the flower deceives the male fly (or bee), and thus causes it to carry pollen from flower to flower.

North of England Microscopical Society.—The annual meeting was held on March 26th, in the Physical Lecture Theatre of

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the Durham College of Science, Newcastle-on-Tyne. Mr. N. H. Martin, F.L.S., president, occupied the chair. During the evening Professor Bedson gave an interesting exhibition of microscopic specimens, enlarged and thrown on the sheet by the aid of the optical lantern. Professor Lebour exhibited and described some microscopic rock sections. It was announced that the head-quarters of this Society will in future be at the Natural History Museum, Barras Bridge.

LIVERPOOL LITERARY & PHILOSOPHICAL SOCIETY.—At the Royal Institution, on April 1st, before a largely-attended combined meeting of the Liverpool Polytechnic and the Literary and Philosophical Societies, Professor Hele Shaw read a paper upon the "Development of the Heat Engine," the subject being illustrated by models and by lime-light pictures. The Professor said the earliest heat engine was described by Hero of Alexandria, about the year 200 B.C. For many hundreds of years no other heat engine appeared upon the scene, and the first authentic account of the revival of attempts to use steam occurred about the year 1600, when they found attempts made to utilise the impulsive action of a jet of steam for the purposes of turnspits and small motive engines. It was reserved for a modern engineer of high scientific attainments—the Hon. Charles Parsons—to show five years ago the possibility of using steam in this way most economically. The true secret of its use was to obtain high speed. This engineer's steam turbine, running at no less than 10,000 revolutions a minute, gave an efficiency which compared favourably with the best modern steam engines. About the year 1,600 attempts began to be made to utilise the direct pressure of steam, but for a long time this was only applied in order to force water. The lecturer then traced the history of the steam engine to the time of James Watt, who first separated the hot and cold parts of the engine. Air engines were next treated of, the gas engines following, from its first form to the present silent engines. Professor Hele Shaw then illustrated by diagrams the result of elaborate trials made by the Society of Arts, showing that the Atkinson gas engine gave the best results of any. The gas engine was much more promising of improvement than the steam engine, and the regenerators now used produced a vast saving in the heat, which was formerly lost by escapement The most successful engine utilising the regenerator was that of Mr. James Hargreaves, of Liverpool, and this engine promised to be the most useful of any heat engine yet produced. Mr. Hargreaves had gone further in the solution of the great problem of storing and re-utilising the heat than had any other scientist. A vote of thanks to Professor Hele Shaw closed the business of the meeting.

Reviews.

Tales of Science. By the Rev. J. G. McPherson, M.A., Ph.D., F.R.S.E., &c. [Edinburgh: James Gemmell.]

THIS volume describes in a pleasant, popular manner many of the remarkable discoveries of late years. It is one of those books which, whilst stating scientific facts and theories clearly, is yet easy to be understood and enjoyed even by the unscientific reader, and is well calculated by its charm of manner to enlist recruits in science studies. It deals not only with what is beautiful and interesting in natural phenomena, but in many ways points out how science can be made practically useful in many directions, and altogether is a book that may well stir up enthusiasm in scientific work.

Sound, Light, and Heat. By Mark R. Wright.
[Longman's Elementary Science Manuals.]

THIS book is a welcome addition to the number of text-books available for the use of elementary students of these branches of science. The author's treatment of the subjects is essentially experimental, and many of the forms of apparatus, and the experiments described, are decidedly more simple than, and quite as efficient as, those frequently found in such works. The illustrations are clear and well chosen, and the diagrams as satisfactory as any we have seen. A valuable feature of the book is the number of examples provided for the student to work out for himself. They number over 400, and include all those given in the elementary papers of the Science and Art Department during the past nine years, the answers to most of them being given at the end of the book. Whether the majority of elementary students in classes under the Science and Art Department possess as much mathematical knowledge as is required in some parts of the book is very doubtful, the experience of most teachers being that their pupils are sadly deficient in that respect. The reasoning, however, is so clear that any student of average ability can have no difficulty in following it.

Theoretical Mechanics. By J. Edward Taylor, M.A.
[Longman's Elementary Science Manuals.]

THIS volume quite maintains the reputation of the series of elementary manuals to which it belongs. Not only is the text as simple as is compatible with the subject, the illustrations homely but forcible, and the reasoning clear, but the sketches of apparatus to illustrate principles, and the diagrams introduced to explain them, are admirable. The book will be found sufficient—as stated in the preface—for the Science and Art Department's examination in the elementary stage, or for the London University matriculation examination in this subject.

Leeds Geological Association. Transactions.
[Parts iii. and iv. 1886-7 and 1887-8.]

A LARGE number of interesting and instructive papers appear in these volumes, and give evidence of the energetic work done by the members of this association in spreading a knowledge of geology in Yorkshire. Amongst the principal papers may be mentioned one by Mr. Thomas Tate on "Oceanic Deposits," of which the author gives the following classification:—1. Shore deposits: Coloured muds, volcanic sand, shell sand, coral sand, nullipore sand, pteropod ooze, glauconite ooze, biloculina ooze 2. Deep sea deposits: Globigerina, radiolarian and diatomaceous ooze, red and grey clays, manganese, native iron, and cosmic dust. The Shap granite district is described by Mr. W. Cheetham. Mr. C. Brownridge remarks upon the occurrence of quartzite and other boulders in the lower coal measures of Wortley, near Leeds; and Professor A. H. Green contributes a short note on some "Structures Common in Sub-aerial Lavas." A portrait of the president of the society (Mr. J. E. Bedford, F.G.S.) is given as frontispiece to part iv. Mr. Bedford contributes to this part some "Geological Notes of the Isle of Man," and Mr. G. W. Lamplugh relates his experiences in the far-famed Yellow Stone region. The inaugural address of the president deals with the subject of the "Oil Fields of America and Russia" in a very comprehensive manner. Mr. W. Cheetham's paper, entitled "From the Millstone Grits to the Silurians," contains a pleasant account of a geological tour through an interesting portion of England, interspersed, however, with occasional touches of non-geological matters. Mr. Holgate's "Brief Notes on the Lake District" will be read with interest. The publication is well got up, and a good feature consists in the lengthy reports of the society's excursions, which are all exceedingly well written in a form so as to be really valuable for future reference, Mr. S. A. Adamson, F.G.S., is the energetic honorary secretary of this association.

Palæontographical Society. Memoirs. [Vol. xlii. 1888.]

A SOCIETY which for over forty years has steadfastly laboured to carry out the work inaugurated by its founders, undeterred by difficulties of age and a diminished roll of members, is deserving of some amount of encouragement. The Palæontographical Society of London has a distinctly national aim, being, in fact, that of striving to spread abroad a knowledge of the vast stores of fossil treasures existing in the strata of Great Britain. The volume just issued is fully equal to the standard of its predecessors. It is enriched with twenty-six fine plates illustrating the following monographs, either complete or in course of publication:—"Stromatoporoids," by Professor Alleyne Nicholson; "Tertiary Entomostraca," by Professor Rupert Jones and C. D. Sherborn; "Jurassic Gasteropoda," by W. H. Huddleston; "Inferior Oolite Ammonites" (Part iii.) by S. S. Buchman; "Devonian Fauna of the South of England," by Rev. G. F. Whidborne. The society is deserving of support

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from all who are interested in palæontology and geology, as its work cannot be said to be fulfilled so long as any British fossils remain unfigured and undescribed.

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Nottingham Naturalists' Society. Transactions and Thirty-sixth Annual Report. 1888.

THIS annual publication, edited by Mr. W. Handley Kay, honorary secretary of the society, contains some good papers in addition to the report of the society's progress, which has been satisfactory. The following papers are printed:—"Evidences of Glacial Action in Snowdonia," by E. Kidson; "The Examination of Potable Waters for Micro-organisms," by E. Francis, F.C.S.; "Notes on the Anatomy and Development of the Lancelet," by J. W. Carr, B.A.; "Symbosis, or Odd-Fellowship in Nature," by Rev. E. Rattenbury Hodges; "Touch and the Genesis of Sensation," by W. J. Abel, B.A.; and "Some Facts in Meteorology," by E. J. Bedford.

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Liverpool Geological Association Journal. [Vol. vii. 1887-8.]

THE eighth volume of the *Transactions* of this flourishing association—which lacks a title-page, the title appearing only on the cover—shows a very satisfactory record of progress. Geology must indeed be a popular study in Liverpool to enable two separate societies to be so well supported. In addition to the publication of abstracts of the papers read at the meetings, several notes and short communications are printed, which add to the interest of the "journal." Accounts of field meetings—always an attractive feature of the work of a geological society—are fully given, the out-of-door meetings including several visits to the museum. No fewer than four papers appear having reference to the Isle of Man, by the Rev. S. Gasking, F.G.S., Messrs. D. Clague, F.G.S., and I. E. George. Mr. C. Potter contributes some suggestive notes on "Some Facts in Connection with the Geology of the Mersey Basin;" and Mr. G. W. Gray, A.I.C., gives a valuable series of analyses of Wolfram ores from various localities. In accordance with the principle that a local society should devote its chief attention to local matters, several papers appear bearing upon the geology of the district, showing that the members of this association are active in recording useful observations. In a paper entitled "The Flexures, Faults, and Slickensides of the New Red Sandstone," Mr. D. Clague, F.G.S. (the honorary secretary) refers to the action of ice in producing the surface crumplings seen in the upper beds of the Trias immediately underlying the boulder clay. The faulted and contorted beds at a greater depth, frequently exhibiting curious slickensided fissures, are attributed to the result of earth movements which accompanied the formation, during Permian and Triassic times, of the great Pennine Fault. Several reports also appear from the respective referees in the departments of mineralogy, microscopical, and chemical geology. The president, Mr. A. Norman Tate, F.I.C. (who is referee in the latter subject), adds a note on the examination of water from a spring in St. James's Cemetery, which showed a large proportion of sulphate of magnesia—19·02 per cent.

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Proceedings of the Yorkshire Geological and Polytechnic Society.
[New Series. Vol. ix. Part 3. 1888. 12 plates.]

THE present number of the Proceedings of this influential society forms a valuable record of work accomplished, the greater part of which is by no means of an ephemeral nature. The subjects treated in this issue are varied, and include physical geology, palæontology, and archæology. In the latter department Mr. J. W. Davis, F.S.A., offers some excellent observations on the discoveries of flint implements which have been made in Yorkshire. Not only in the East Riding, where the chalk wolds are replete with flint nodules, but also in the high ground bordering the county westward, where no flint occurs locally in the strata, large numbers of flints have been found, some of exquisite workmanship. The various localities of their occurrence are described, and speculations made as to the age and origin of early man in Britain. Mr. Davis does not consider that any relics yet discovered reveal traces of the *earliest* races of men inhabiting Yorkshire. Amongst the geological papers the palm must be given to one entitled "Yorkshire Petrology," by Mr. Thomas Tate, F.G.S., illustrated with a well-drawn plate showing micro-sections of mica-syenite, from Ingleton, and other drawings. Mr. Tate enters into an exhaustive account of the lamphrophyres, a most interesting series of igneous rocks composed of orthoclase, hornblende, and biotite. Mr. G. W. Lamplugh contributes papers on the "Boulders of Flamborough Head" and "A Buried Cliff at Sewerby, near Bridlington." Another contribution of importance is that by Mr. W. Cash, F.G.S., on "The Fossil Fructifications of the Yorkshire Coal Measures," which is also illustrated with several sections. One paper, dealing with a district out of Yorkshire, gives a lucid account of the distribution of the entomostracea in the Wenlock shales, in which Mr. G. R. Vine details the results of a series of "washings" by Mr. Maw from the Buildwas Beds. Mr. S. A. Adamson is well to the fore in an excellent description of the strata exposed during the construction of the Skipton and Ilkley Railway. The proceedings of the jubilee meeting of the society appear *in extenso*. Professor Judd on this occasion gave an address on "The Relation between the Central Societies and Local Ones," laying stress upon the benefits arising to science from the spread of local societies. A bibliography of all geological literature relating to Yorkshire published during 1887 is a useful addition to this very praiseworthy volume of Proceedings.

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The Library. [Elliott Stock, London.]

THE numbers of this new magazine of bibliography and literature have promptly made their appearance. Amongst the contents we note an interesting paper by William Blades on proposals made nearly two centuries ago to found public libraries. A (now rare) tract with this object was printed in the year 1699. The writer was the Rev. James Kirkwood, a native of Dunbar, who deserves to be honoured as an early pioneer in the public libraries movement in Scotland. *The Library* contains a large amount of intelligence, and items of interest not only to librarians and curators but to book-lovers in general. The "Museum Notes" appear to be restricted to the national collections. The magazine is well printed on good paper. The price of each monthly number is eightpence.

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Sunlight. By the Author of "The Interior of the Earth." 2nd Edition, with alterations and additions.
[London: Trübner and Co.]

THE author of this work is Mr. H. P. Malet, who is also known as a writer of other books and papers in which accepted notions of modern geologists are severely handled. Mr. Malet states in his preface that his chapters or "sections are all founded on personal observation of natural facts." On this account we have not debarred ourselves from perusing his work by reason of the (to say the least of it) extraordinary nature of the argument presented in his pages, but have most carefully and conscientiously gone through the whole of the matter before us. In an age when dillitanteism is so greatly prevalent, even in science, it is more than ever necessary that the truth-seeker should first master elementary principles of the subject in hand before launching out into the world of conflicting theories. We do not accuse Mr. Malet of having neglected this precaution at the outset of his "personal observations," but have to regret that the language he has chosen to employ is so exceedingly vague that we are frequently at a loss even to comprehend his meaning. In no subject more than in science, especially where intricate physical problems are concerned, is it necessary to exercise the most extreme care that the author's form of expression should be such as to preclude the possibility of doubt arising in the reader's mind as to the meaning which the author intended to convey. It is to be regretted that many modern scientific works are so much wanting in clearness of exposition, which is the highest desideratum in scientific writing. The greatest difficulty in comprehending Mr. Malet's various explanations of natural forces and other phenomena—next to the difficulty in believing that these phenomena could have ever been the result of any such operations as he endeavours to describe—lies in the want of coherence in his illustrations and arguments. Thus, on page 96, under the heading of "Section XII. Gravitation and Attraction," we read:—"Light, as the first agent of creation, brought two forces on the scene. One, gravitation, was developed by abstraction of gaseous matter; the other, attraction, became the assistant in construction." What means this imbroglio? Section XVI., entitled "The Ocean Bed and the Moon," opens with the statement that "There is no intention of referring to the moon for evidence of actions in or on this earth;" and, to do the author justice, we must admit that the moon is never once referred to again in the course of the

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chapter. We are reminded of the schoolboy's essay on snakes in Iceland—"There are no snakes in Iceland." One of the longest chapters in the book is devoted to earthquakes and volcanoes, and the style of argument used may be taken as typical of the whole. These two phenomena are, we are told, "as closely related to each other as rivers and mountains; but as rivers may exist without mountains, so earthquakes may take place in regions where there is nothing volcanic or heating in the rocks or in the water." The theory of increasing heat as we descend in the earth is dismissed as being "too ridiculous to discuss fully." There is, we are told, "no proof of innate inherent heat in the earth" (p. 151). The author also denies that there is any heat in the sun (Ib.). According to him the land did not rise from the water, but the ocean bed subsided, leaving our present mountains as dry land (p. 115). Polished and stunted rock-surfaces are not the result of glacial action (p. 51), but are due to running water. Basaltic formations are the result of early meteoric dust; their structure is due to waves or currents (p. 131).

Space will not permit us to add to these examples. Probably those which we have given will suffice to indicate the peculiar line of thought adopted by the author. The object of all these chapters, as stated in the opening one, is "to expand the Mosaic teaching," as well as to show that "light without fire did create this earth and all life on it." Other somewhat similar attempts have been made to "reconcile," as it is termed, ancient dogmas with modern science, and a cognate work, which has been before the public for some time, was written by Dr. Kinns. The old adage that "two of a trade never agree" holds good here as in other cases, and we are not surprised to find that Mr. Malet and the author of "Moses and Geology" are by no means in accord upon the subject. The latest apostle of sunlight accuses Dr. Kinns of endeavouring to fit "much false geology into his own interpretation of Scripture." We fear we cannot acquit the present author from a similar procedure. Nor are we satisfied that the author's method of investigation, the *rationalé* of which is but vaguely apparent, is an advance upon that usually known as the "scientific method," of which it does not appear that Mr. Malet has grasped even the elementary principles. It seems to us that the only true method of interpreting nature is by continually testing a tentative theory by appealing to each of the accumulated facts and observations. Mr. Malet's theories of cosmogony are not, we feel bound to say, borne out by any "proofs" given in his book, and in future attempts to unravel the mysteries of nature we should certainly recommend him to be more clear in explaining his meaning. The leading point of his book is "light"; yet he never gives a satisfactory explanation of what he considers "light" to be. It is in one place referred to as a *force* ("Light is a distinct force," p. 151), and at another it is distinctly regarded as "sensitive though impalpable *matter*." We fail to reconcile these two ideas; and as in every branch of knowledge definitions of some kind are necessary before we can make much advance, we fear Mr. Malet's work will not throw much light on some of the problems, already sufficiently perplexing, at which science is now working. With one sentiment expressed by Mr. Malet in his concluding chapter we entirely concur, accepting for the nonce his own imagery—"There is a difficulty in finding the end of a circle that has a chaotic beginning."

O. W. J.

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Evidences of the Antiquity of Man in Leicestershire. By Montagu Browne, F.G.S.

In this interesting pamphlet, which is written by the curator of the Town Museum, Leicester, we have a detailed description of relics of man's handiwork in bone, horn, pottery, and bronze, which have come down to us from early pre-historic ages. The neighbourhood of Leicester seems to have been rich in such archæological treasures, but we gather that all the stone implements described are neolithic, and that no traces have been found of the existence of palæolithic man in the county. The paper is embellished with three collotype plates, giving photographic reproductions of implements, bones of extinct animals, perforated hammer-heads, spindle whorls, and other objects. The date of most of them appears to be "late Celtic."

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A Revised Catalogue of Variable Stars. By J. E. Gore, F.R.A.S.

A revised catalogue of all stars now certainly known to be variable in light has become a desideratum. This communication, originally presented to the Royal Irish Academy, is based on observations taken near Ballysoetare, county Sligo, with a binocular field glass. It is brought up to date, possesses remarkable completeness, and will be invaluable for reference by astronomical students.

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The Geology of North Cleveland. By George Barrow, F.G.S. (Geological Survey Memoir.)

The important district comprising the coast of Yorkshire from the mouth of the Tees to beyond Whitby, and including the Cleveland hills and moors, forms the subject of one of the latest additions to the memoirs of the Geological Survey. In no other part of England is the relation of the surface topography to the nature of the underlying rocks more instinctively displayed, nor can the succession of the Jurassic formations be anywhere more advantageously studied. The memoir gives an explanation of quarter-sheets 104 S.W., S.E., and is illustrated with numerous sections. The economic geology of the district, with its ironstone mines, jet-workings, and salt beds receives a full share of attention.

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Vannin Lioar. Edited by P. M. C. Kermode, M.B.O.U., F.S.A.Scot. [Ramsey: J. Craine. No. 1. Jan., 1889.]

This forms the first number of a new journal, to be published quarterly, for the Isle of Man Natural History and Antiquarian Society, with which will be incorporated the *Transactions* of the Society. The present issue contains much matter of general interest to students of Manx natural history. Amongst other articles may be mentioned:—"On the Geology of the Isle of Man," Professor W. Boyd Dawkins, M.A.; "Brassica Monensis," Rev. T. Talbot; "Our Insect Enemies," P. M. C. Kermode; together with an excellent summary of meteorological and phenological observations.

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The Photographic Societies' Reporter. Edited by C. W. Hastings and Lyonel Clark.

[London: Hazell, Watson, and Viney, Limited. Vol. 1. No. 2.]

A monthly journal established for, and devoted entirely to, the publication of papers read before photographic societies and the discussion thereon, is a decided novelty, and the number of these societies is now so large that a literary organ of the kind seems desirable. The present issue gives full reports of the meetings of some fifty societies in different parts of the country.

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The *Naturalists' Gazette* has made its appearance, and claims to be the only penny monthly scientific paper. The contents are interesting, and the magazine will doubtless be useful to a large class of scientific students interested in natural history.

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A new Journal for "the amateur, the profession, and the trade" of *Photography* has appeared under that title. The number of those persons who find photography useful as a relaxation or as an aid to special studies is growing so large that several journals are already in existence to meet the wants of the fraternity of the camera. The new venture is published at the popular price of one penny, and is certainly an excellent production for the money.

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The first two numbers have appeared of a new monthly journal devoted to the interests of life assurance, published in Manchester under the title of *Assure*, and edited by Mr. A. Arthur Reade. The first number contains a short article by the editor on the late Mr. R. A. Proctor, whose widow has recently been granted a pension from the civil list. The journal should do good in the direction in which it aims.

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An excellent feature of *The Naturalist* (edited by W. D. Roebuck, F.L.S., of Leeds) is the publication of annual bibliographies of the different branches of natural history. The references in these papers are confined to subjects connected with the North of England, and are invaluable to naturalists, who are now placed in possession of the titles and abstracts of all papers published bearing upon their science. The issue for January contains a bibliography of the diptera; and the numbers for February and March contain a very carefully-compiled list of papers and records in geology and palæontology for 1887, the work of Messrs. S. A. Adamson, F.G.S., and Alfred Harker, F.G.S.

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List of the Plants of the Isle of Man.—Part II.

By the Rev. Samuel Gasking, B.A., F.G.S.,

Corresponding Member of the Isle of Man Natural History and Antiquarian Society, Member of Council of Liverpool Naturalists' Field Club, &c.

Lathyrus macrorrhizus—Tuberous bitter vetch.

Order 26.—*Rosaceæ.*

Prunus communis—Sloe.
A. spinosa.
Do. cerasus—Cherry.
Spiræa ulmaria—Meadow sweet.
Geum urbanum—Wood avens.
Potentilla anserina—Silver weed.
Do. reptans—Creeping cinque-foil.
Do. tormentilla—Tormentil.
A. officinalis.
B. procumbens.
Do. fragariastrum—Strawberry-leaved cinque-foil.
Comarum palustre—Purple marsh do.
Fragaria vesca—Wood strawberry.
Rubus saxatilis—Stone blackberry.
Do. idæus—Raspberry.
Do. fruticosus—Common blackberry.
Do. carpinifolius—Hornbeam-leaved do.
Do. Kœhleri—Kœhler's do.
Do. glandulosus—Glandulous do.
Do. corylifolius—Hazel-leaved do.
Do. cæsius—Dewberry.
Rosa spinosissima—Burnet-leaved rose.
Do. tomentosa—Downy-leaved do.
Do. rubiginosa—True sweet-briar.
Do. canina—Common dog rose.
Do. arvensis—Trailing rose.
Agrimonia eupatoria—Common agrimony.
Alchemilla arvensis—Parsley-piert.
Cratægus oxyacantha—Hawthorn.
Pyrus malus—Crab apple.
Do. aucuparia—Mountain ash.
Epilobium angustifolium—Rose bay willow-herb
Do. parviflorum—Small-flowered willow-herb.
Do. montanum—Broad smooth-leaved do.
Do. palustre—Narrow-leaved do.
Do. alsinifolium—Chickweed-leaved do.
Circæa lutetiana—Common enchanter's nightshade.

Order 28.—*Haloragiaceæ.*

Hippuris vulgaris—Mare's tail.
Callitriche verna—Vernal water star-wort.

Order 29.—*Lythraceæ.*

Lythrum salicaria—Upright purple loose-strife.
Peplis portula—Water purslane.

Order 30.—*Tamariscaceæ.*

Tamarix Anglica—English tamarisk.

Order 32.—*Portulacaceæ.*

Montia fontana—Water blinks.

Order 35.—*Grossulariaceæ.*

Ribes nigrum—Black currant.
Do. rubrum—Red do.
Do. grossularia—Gooseberry.

Order 36.—*Crassulaceæ.*

Sedum rhodiola—Rose-root stonecrop.
Do. telephium—Livelong.
Do. Anglicum—English stonecrop.
Do. acre—Wall-pepper.
Sempervivum tectorum—House-leek.
Cotyledon umbilicus—Penny-wort.

Order 37.—*Saxifragaceæ.*

Saxifraga geum—Kidney shaped saxifrage.
Do. aizoides—Yellow mountain do.
Do. oppositifolia—Purple mountain saxifrage.
Do. tridactylites—Rue-leaved do
Chrysosplenium oppositifolium—Common golden do.

Order 38.—*Araliaceæ.*

Hedera helix—Ivy.

Order 40.—*Umbelliferæ.*

Hydrocotyle vulgaris—White-rot.
Sanicula Europæa—Wood sanicle.
Eryngium maritimum—Sea holly.
Conium maculatum—Hemlock.
Smyrnium olusatrum Alexanders.
Cicuta virosa—Cowbane.
Helosciadium nodiflorum—Procumbent marsh-wort.
Carum verticillatum—Whorled caraway.
Bunium flexuosum—Earthnut.
Pimpinella saxifraga—Common burnet saxifrage.
Œnanthe Lachenalii—Parsley water drop-wort.
Do. crocata—Hemlock do.
Do. phellandrium—Fine-leaved do.
Æthusa cynapium—Fool's parsley.
Fœniculum vulgare—Fennel.
Crithmum maritimum—Samphire.
Angelica sylvestris—Wild angelica.
Heracleum sphondylium—Cow parsnep.
Daucus carota—Wild carrot.
Torilis anthriscus—Upright hedge parsley.
Scandix pecten-veneris—Shepherd's needle.
Anthriscus sylvestris—Beaked parsley.
Chærophyllum temulum—Rough chervil.

Order 42.—*Caprifoliaceæ.*

Sambucus nigra—Common elder.
Do. ebulus—Dwarf do.
Viburnum opulus—Common guelder rose.
Lonicera periclymemum—Honeysuckle.

Order 43.—*Rubiaceæ.*

Galium verum—Yellow bed-straw.
Do. palustre—White water do.
Do. uliginosum—Rough water do.
Do. saxatile—Smooth heath do.
Do. aparine—Goose-grass.
Sherardia arvensis—Field madder.
Asperula odorata—Sweet woodruff.

Order 44.—*Valerianaceæ.*

Centranthus ruber—Red spur valerian.
Valeriana officinalis—Great wild valerian.
Valerianella dentata—Smooth corn salad

Order 45.—*Dipsaceæ.*

Scabiosa succisa—Devil's-bit scabious.
Do. columbaria—Small do.
Knautia arvensis—Field knautia.

Order 46.—*Compositæ.*

Leontodon hirtus—Hairy hawkbit.
Do. autumnalis—Autumnal do.
Hypochœris radicata—Long-rooted cat's ear.
Lactuca muralis—Ivy-leaved lettuce.
Sonchus arvensis—Corn sow-thistle.
Do. oleraceus—Sharp-fringed do.
Crepis virens—Smooth hawk's beard.
Hieracium pilosella—Mouse-ear hawk-weed.
Do. boreale—Northern do.
Taraxacum officinale—Common dan delion.
Lapsana communis—Nipple-wort.
Arctium lappa—Common burdock.
Carduus crispus—Welted thistle.
Do. tenuiflorus—Slender-flowered do.
Do. marianus—Milk do.
Do. lanceolatus—Spear do.
Do. palustris—Marsh do.
Do. arvensis—Creeping do.
Onopordium acanthium—Cotton thistle.
Centaurea nigra—Black knap-weed.
Bidens tripartita—Trifid bur-marigold.
Eupatorium cannabinum—Hemp agrimony.
Tanacetum vulgare—Tansy.
Artemisia maritima—Sea wormwood.
Variety.—*Gallica.*
Do. absinthium—Common do.
Do. vulgaris—Mugwort.
Antennaria dioicum—Cat's foot.
Do. margaritaceum—Pearly everlasting.
Gnaphalium sylvaticum—Highland cudweed.
Do. uliginosum—Marsh do.
Filago minima—Least filago.
Do. germanica—Common do.
Petasites vulgaris—Common butter-bur.
Do. fragrans—Fragrant do.
Tussilago farfara—Colt's-foot.
Aster tripolium—Sea star-wort, or Michaelmas daisy.
Solidago virgaurea—Golden rod.
Senecio vulgaris—Common groundsel.
Do. sylvaticus—Mountain do.
Do. erucifolius—Hoary ragwort.
Do. jacobæa—Common do.
Do. saracenicus—Broad-leaved do.

(TO BE CONTINUED).

Moss Agates.

By F. P. Marrat, *Liverpool Free Public Museum.*

THE geologist in his investigations is compelled to search for information in the three kingdoms of nature:—First, the mineral kingdom, then the vegetable kingdom, and, lastly, the animal kingdom. In all cases the greatest amount of evidence in all its bearings is chosen. Thus, in the case of the green material, although the branched and single filiments are uniform in size, they have no parallel in the mineral kingdom. All the fibrous materials in the mineral kingdom are without the seaweed character, which so wonderfully distinguishes the true moss agates, and all the evidence evolved in the study of these silicified filaments is in favour of their being what their appearance first suggests—algæ. The seaweeds enclosed in the siliceous matrix are not always in a confused and inextricable mass, but those enclosed whilst growing show all the evidence of a slow stream action, and some of these are as decided in this character as the algæ beautifully and tastefully displayed in a lady's botanical album—not a single branch is found to be out of place.

All the stones passing under the term of moss agates do not enclose algæ, nor do many of the green stones contain a particle of chlorophyll, but owe their green colour to the minerals chlorite, greenearth, talc, serpentine, or the various salts of copper. A person must be very deficient in acumen who could mistake the dendritic manganese of a mocha stone for a moss. Both reason and care are required when examining specimens of these minerals, otherwise mistakes may be easily made, resemblances may be mistaken for identities, and blunders of a serious character may follow any act of carelessness. Both opal and chalcedony are forming as rapidly to-day as they did in the time of the earth's earliest history, and these plastic materials are quite as likely to form round a seaweed nucleus as the silica of a flint of the chalk should envelop an echinus, a choanite sponge, or a polyzoon. In my opinion the evidence in favour of these being *plants* is quite as strong as that a fossil shell or echinoderm has once been a living organism.

The late Captain Whiteway informed me that when in Valparaiso he met with a very intelligent Spanish gentleman, who had been travelling in the interior of South America, and who related the following curious circumstance regarding some silicified trees he had seen. He said the trees were such as are now growing in the forest, upon whose river banks the prostrate trees were lying, and that the fresh-water weeds were growing attached to the immersed sides of the trunks, and that in several instances the clear chalcedony had formed as a kind of overflow and enclosed all the organisms in the immediate vicinity. The long, slender, hollow stems and branches, are sometimes distinctly jointed at regular intervals, and in fact are plants which so closely resemble the algæ of our ponds, rocky sea shores, and ditches, as to leave very little doubt in the mind of a botanical observer as to their being plants around which soft, gelatinous, soluble silica has been deposited. The algæ appear to me to have been simply incrusted with a thin coating of silica, which has not penetrated into the minute pores of the epidermal layer of the plant.

The general appearance of many of the enclosed specimens is so like the living plants that it would not appear strange for a botanist to name or classify them. Root-like appendages are found attached to the stems, such as occur in the recent genus *Rhizoclonium*. Again: we find short, rounded appendages similar to those we are accustomed to see in the genus *Vaucheria*; algæ, with hollow stems and bright green chlorophyll, enveloping the cavity and appearing as fresh as if just removed from the water; plants with leaves a quarter of an inch broad, and not unlike a recent enteromorpha leaf, and apparently with just such a smooth surface as the recent plant has; the genus *Ectocarpus*, with its filamentous stem and repeatedly forked delicate

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branches occurs amongst the ever-preserved species. In a moss agate in my cabinet are some small radiated tufts of an algal, with filaments about an eighth of an inch long, resembling a detached cluster of *calethrix confervicola*. Even the delicate shades of green, so commonly to be met with amongst marine and fresh-water plants, are easily recognised accompanying the specimens enclosed in silica.

Letters to the Editor.

Notice to Correspondents.

It is important that Letters to the Editor should be as brief as possible and to the point, as it is difficult to find space for lengthy communications. Several letters received have been quite too long to be published in full, and we regret that we cannot find room for them in this number.

A Lately Discovered Variety of Tree Trap-door Spiders.

Sir,—I have recently received from Miss L. Jones, of Gateacre, two novel tree trap-door nests and spiders that were discovered in the forests within a radius of fifteen miles of San Paulo, Brazil, by her brother, Mr. E. Dukenfield Jones, C.E., and of which allied species originally were discovered for the first time on October 10th, 1874, by Dr. Dyer, of Uitenhage, South Africa, and again on August 28th, 1875, and, so far as I know, they were supposed to be confined to that country only.

I see no reason why, by searching for them, they should not be obtained both in the eastern and western hemispheres, especially in New Zealand, Australia, Demerara, Ceylon, Borneo, and Java; and I shall be glad to receive from any observers any new specimens they may find, so as to enrich my collection at the Free Museum in Liverpool, and I shall always be pleased to acknowledge any contributions with thanks.

I desire to inform collectors generally that these tree spiders assimilate their nests so closely to the bark of the tree as to require very careful search to detect them. The successful mimicry of the bark by these creatures will well repay the collector for all his trouble.

I am sorry to say that the nests and spiders, on their way to the Rev. O. P. Cambridge to be named, in a great measure came to grief by the postal authorities, much to my annoyance and disappointment, as you may suppose. I received, however, a letter from Mr. Cambridge since the occurrence to say that he had managed from the fragments to make a drawing of both of them, which will appear in the next number of the *Proceedings* of the Zoological Society of London, and that he had given it the name of *Dendricon rastratum* (O. P. Cambridge). I hope to be able to send you a proof of the engraving for your June number.

Rainhill, Liverpool, April 12th, 1889. Fredk. Taylor.

Sparrows and Farm Crops.

Sir,—You intimate in *Research* for February, Notes in Brief, p. 128, that you expect Nemesis to overtake the Wirral farmers for their slaughter of sparrows, thereby hinting that the farmers are destroying the "balance of nature." Are you quite sure that they are not rather restoring that balance? Do not sparrows obtain from farms and gardens supplies of food more abundant in quantity, better in quality (as cereals and cultivated fruit), and in a more circumscribed area than a state o nature would afford them? In the neighbourhood of the farmers' fields builders leave innumerable holes and ledges where the sparrows may make their homes and rear their young secure from many of the enemies who would naturally reduce their numbers. And in winter kindly people prevent them from starving by providing them with food, of which the quantity given must, in the aggregate, be enormous. Is it not thus probable that sparrows have increased abnormally? It may be that the farmers find, as a consequence, Nemesis has already arrived at their gates.

According to report, Miss Ormerod says that sparrows do not eat insects. My own observation confirms this. I have never detected them interfering with insects; but see them eat scraps thrown from houses, as bread, porridge, boiled potatoes, apples, &c., seeds of plants, certain green plants; and they often squeeze the juice from a thick part of the stem, leaving the terminal portion hanging or severed, so destroying but not eating it. They peck green buds of shrubs and trees—gardeners have to leave roses, &c, untrimmed in the autumn to save them from being ruined by these and other birds. They also tear primroses into little pieces and nip the stems of crocuses, their object, I think, being to get the honey. For some years I have, in these cases, circumvented a few of the little rascals by shaking pepper over the primrose buds and leaves when they first appeared, and down the tubes of the crocus blossoms as soon as the corolla had fully opened, renewing after rain occasionally, thereby insuring plenty of bloom when my neighbours had none.

Sparrows may do good in towns of bad sanitary arrangements by clearing away what would otherwise decay, and perhaps they help to keep down weeds in wild parts of the country.

Do you know whether the Farmers' Club have had the crops of any of the birds examined? If this were done on an extensive scale by a competent person, the information obtained might be valuable. Lucy J. Halcrow.

Geological Photography.

Sir,—At the last meeting of the British Association, held at Bath, a proposal was made to appoint a committee to collect and register photographs of localities, sections, and features of geological interest in every county of the United Kingdom. Isolated attempts at a photographic survey of certain counties or districts have already been made by several of our local societies, but the need is felt to secure uniformity of action by all the societies interested, and to arrange for the photographs to be available for teaching or other purposes when needed. The proposal was referred to the committee of delegates of the corresponding societies, who have issued in their report (a copy of which has been sent to the leading societies in the country) a number of suggestions relating to the work of the proposed committee on geological photography. Many leading geologists, not only of our country but also of America, warmly supported the scheme. It was ultimately decided to defer the question of the appointment of a committee until the meeting this year at Newcastle, the delegates in the meantime to interest their societies in the matter, and endeavour to promote a harmonious result.

My object is now to ask the aid of those readers of your valuable and widely circulated journal who have interested themselves in the photography of local geological features—especially of typical and temporary sections—in supplying me with the following information:—(1) A list of photographs already taken illustrating given localities or sections; and (2) the names of local societies or persons who may be willing to arrange for a photographic survey for geological purposes in their district.

The information gained will be placed before the geological section of the British Association, at their meeting in September next, and I hope it will be of such character as to induce systematic steps to be taken for the purpose I have named. If copies of photographs are sent me they will be carefully kept to be exhibited at the meeting. Several geological friends have favoured me with hints and suggestions in regard to size of the photographs, scales of height and length, and other details, which will all be carefully considered. Photography is now so popular and easy of accomplishment that there should be no difficulty in organising a general photographic geological survey.

Communications may be addressed to me as at foot.

12, Queen's-road, Rock Ferry, Cheshire, Osmund W. Jeffs.
April 15, 1889.

Ozone in the Lake District.

Sir,—Whatever may be the learned opinion as to the value of ozone as a factor for invigorating the human body, the following results of observations of the amount of ozone recorded in the Lake District between the 4th and 10th inst., by the Rev. T. Mackereth, F.R.A.S., &c., of Woodland Terrace, Windermere, contrasted with that recorded here on the same days, will be interesting:—

	4th	5th	6th	7th	8th	9th	10th	Totals.
Windermere	4	7	7	9	5	6	9	.. 47
Bolton	1	0	0	0	0	2	0	.. 3

The ozone-papers were sent from Bolton for the experiment, and cut from the same sheet as those simultaneously used here, and afterwards returned to Bolton for the amount of discolouration to be read by the same graded scale—0 to 10.

The above comparison was made because of the great disparity between the ozone recorded since Mr. Mackereth settled at Windermere. During the five months ending March 31st, 1889, the difference had been—

	Nov.	Dec.	Jan.	Feb.	Mar.	Mean.
Windermere	7·13	2·9	2·9	5·1	4·5	.. 4·5
Bolton	2·0	0·3	0·9	2·75	1·8	.. 1·55

May not the well-established reputation of Windermere as a health resort be in large measure owing to the remarkable proportion of ozone in the district?

W. W. Midgley, F.R.Met.So.

Observatory and Museum, Bolton, April 12, 1889.

Obituary.

M. Michel Chevreul.—The death of this famous French chemist is announced at the more than patriarchal age of one hundred and three years. He was born at Angers, in 1786, and secured a high rank amongst the eminent men of science of this century. Besides his researches into the chemistry of oils and in the processes of dyeing, he will be recollected for his studies in colours, and for the invention of the stearine candle, which replaced the old-fashioned "dip" made of tallow. M. Chevreul occupied the positions of Professor and, afterwards, Director of the Museum of Natural History. He was regarded as perhaps the only living witness of the stirring scenes of the French Revolution.

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This Number completes Vol. I. of RESEARCH. Cases for Binding, Price 2/-, or by post 2/3, may be obtained on application to Mr. E. O. Windel, 9, Hackin's Hey, Liverpool.

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☞ *Index to Volume I. will be given with the July Number.*

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of news and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Granite,

From a Geological and Economic Standpoint.

By J. SHEARSON HYLAND, Ph.D., M.A.

(*Of H. M. Geological Survey of Ireland*).

Part I.

THE importance of bringing science to bear upon the selection of stones used for building purposes is daily becoming more and more manifest to all those whose task it is to select materials suitable for use in the erection of public and private buildings. There is apparent, in fact, a strong tendency to utilise to a practical advantage the knowledge acquired by the geologist of the changes that rocks undergo. Seeing that the subject is as extensive as it is important, it is desirable for the purposes of this paper to confine our attention to one only of the materials employed in the erection of durable structures, viz., granite.

Granites have been used both in ancient and modern times, and, when well selected, form an excellent and durable material; but it is evident that builders have been more frequently inclined to consider the rapidity with which a stone can be worked rather than its stability as a mass. Instances of this false economy are especially common in this country.

Before, however, entering upon this practical aspect of the subject, we should first inquire into the composition and origin of granite. There is probably no stone so well known to the outsider, although many rocks that come into the market under this name cannot scientifically be classed under this head.

If a lump of broken granite be taken and drawn across a piece of common window-glass, it will be seen to scratch the latter, and must, therefore, be harder than that which it marks. What makes a rock hard? It is the physical condition of its constituent minerals, and the manner in which they are held together. By the physical condition of a mineral we chiefly understand its hardness with relation to a given scale, and its degree of freshness, *i.e.*, whether chemically altered or not. The scale of hardness in use amongst mineralogists is divided into ten degrees, each denoted by the name of some mineral. It is as follows:—

1. Talc.
2. Rock-salt or gypsum.
3. Calcite.
4. Fluor-spar.
5. Apatite.
6. Orthoclase (felspar).
7. Quartz.
8. Topaz.
9. Corundum.
10. Diamond.

Talc and rock-salt are the only two which can be scratched with the finger-nail, the former more easily than the latter. Rock-salt scratches talc, hence it is harder. Quartz does the same on all the foregoing six degrees, and is, therefore, harder than any of them. Glass is almost as hard as apatite, hence can be scratched by orthoclase, quartz, &c. Therefore, since granite scratches glass, it must contain some minerals harder than apatite. If we examine again our piece of granite, we will find that the chief constituents are three in number. The first of these is *quartz*, which may be recognised by its glassy lustre, by its greyish or smoky-greyish colour, and by its not being scratched by a knife. The second is *felspar*, which may be present in a variety of

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colours—white, grey, brown, or even green. It can be distinguished from quartz by its lack of transparency and by its becoming scratched with the knife. These are the two minerals whose presence in the granite causes the glass to become marked. The third of the chief constituents is *mica*, which may be either white, brown, black, or light yellow; it is usually characterised by the readiness with which it may be split up into thin flakes or six-sided plates with the knife. These three constituents must always be present in a true granite. If one of these be wanting, the rock belongs no longer to this group. Accessory minerals are those which occur sporadically in a rock, and which do not, therefore, affect to any large degree its mineralogical or lithological character. Such a mineral is *hornblende*, which may be white, grey, black, brown, or green, its usual colour being, however, black or green. It is often similar to mica in appearance, but may be distinguished from the latter by its not "peeling off" in the thin flakes or plates so characteristic for that mineral. Another accessory mineral is *schorl*, or, as it is also styled, *tourmaline*, and mostly occurs in black, needle-shaped, isolated or radiating crystals. This mineral is, however, found as a constituent of granite in one district in such quantities that it practically takes the place of the mica, and the rock (which has become historical from its having been used for the Duke of Wellington's sarcophagus in the crypt of St. Paul's) has received the special name *Luxullianite*, from its occurrence at Luxullian, near Lostwithiel, in Cornwall.[1] This rock is only found in the form of boulders, not *in situ*, but has never been met with in any other parts of the world. The only other accessory minerals which need be mentioned here are *tin-ore* (Cornish granite), and the precious stones beryll and topaz, which are found in the cavities of the granite of the Mourne Mountains.

It has already been stated that many so-called granites are, scientifically speaking, not true granites. Many cases occur where the *hornblende* becomes an important constituent in the rock, and such rocks should in these cases be termed "Hornblendic granites." In fact, this mineral may take the place of the mica, and then we have a rock composed of quartz, felspar, and hornblende as essential constituents, a type, which some geologists would call *Syenite*, a name which Pliny[2] gave to the rock quarried near the Egyptian city of Syene[3]; but this rock has since been shown to be not *true syenite*. A curious variety is that known as graphic granite (*pierre hébraique*). This occurs when large crystals of felspar are so intergrown with the quartz that the rock appears covered with Hebrew-like markings. Such granites are found in Connemara, but are mostly confined to the continent.[4]

Attention should here be drawn to the so-called porphyritic granite. This is a rock which possesses a fine-grained ground mass, in which large crystals of felspar, often six inches long, occur, thereby causing a marked contrast. These large felspars are termed "porphyritic constituents," and appear to project boldly out of the mass. Such a porphyritic granite is the Peterhead stone, which has a rich pink colour. It is especially admired on this account, and there are indeed few rocks in this country which are superior to it for richness of colour and suitability for ornamental purposes.[5]

To return to our piece of granite: if we examine it closely, we will notice that there is no cementing material present; in fact, the rock is crystalline, being composed entirely of crystals or crystalline particles. The compactness is due to the adhesion of the constituents to each other, and they may be said indeed to interlock each other. An examination of a section of a typical granite under the microscope shows that the quartz fills up the empty spaces of the whole, or, in other words, the formation of the crystalline quartz served as the binding material (Ger. *bindemittel*) of the whole. The felspar is seen to occur in well-developed crystals, an observation which proves that, during the period each individual felspar was forming, there was room in the liquid mass for it to develope its characteristic crystal faces. The occurrence of the mica is somewhat irregular, whilst the quartz shows, in contrast to the felspar, no clear crystallographic outlines; it evidently lacked for the formation of its facets that space which the law of crystallization demands, and had to accommodate itself to circumstances. It possesses, therefore, an irregular form, but has that arrangement of its molecules typical of the crystallization process. This irregularity of outline establishes the important fact that the quartz is the youngest mineral in the rock, or, in other words, it was the last to form and consolidate, and was hence obliged to content itself with filling the interstices between the pre-existing constituents. Economically this is highly important. Of all the constituents quartz is less liable to decomposition, and, since it plays the part of an "interlocker," it is not difficult to see how its resistance to the atmospheric agencies helps to keep the rock together. If, for instance, the felspar, which weathers much quicker than quartz, had been the last to form, the granite would not exhibit that degree of durability it is known to possess; for, the felspar once decomposed, it could be removed by the agency of percolating water, and, the other constituents being thus released, the rock would fall asunder.

(To be continued.)

[1] cf. Pisani. *Comptes Rendus*, lix., 1864, 913.
[2] *Historia Naturalis*, xxxvi., 13.
[3] The Assouan of to-day.
[4] cf. *Zirkel, Lehrbuch der Petographie.* Vol. i., p. 493.
[5] Hull. *Building and Ornamental Stones.* 1872. p. 23.

Notes in Brief.

Several local photographic societies are now engaged upon "surveys" of their district, following the excellent example shown by the Birkenhead society. There is enormous field for such work in London and all large cities. The Manchester Photographic Society and the Sheffield Camera Club are amongst those who have organised systematic survey work, with a view of recording everything that is locally interesting from an historical, antiquarian, or topographical point of view.

One of the numerous scientific congresses at the Paris Exhibition will be devoted to photography, and will meet from August 6th to 17th.

At the Camera Club, London, a series of exhibitions of the representative work of single photographers is being held, all the pictures shown being taken by one person. In this way the public obtains a good idea of the individual styles of different photographers, the productions of one man after another being submitted to them for their approbation.

The present year, 1889, is the jubilee of photography. Sir Henry E. Roscoe took occasion to refer to this circumstance in his eulogy of the photographic art, when responding to the toast of "Science" at the recent Royal Academy banquet.

Some fine photographs of the Emperor of Morocco's palace at Tangier have been obtained by Mr. Valentine, of Dundee, who is the first to whom the privilege of photographing the interior of the palace has been accorded. Mr. Valentine has been successful in reproducing peculiar effects of sunlight and shade, by which the art of the Moors has been rendered exceptionally striking.

In considering the work of recreative evening schools, Mr. A. A. Baumann, M.P., in a recent speech at Chelsea, made a sensible suggestion to arrange for popular geographical lessons, illustrated by the lantern. There is much to be desired in the ordinary method of teaching the important subject of geography, and it is remarkable that the facilities of the optical lantern have not more often been brought into requisition.

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AT the annual meeting of the Royal Institution of London, it was stated that the real and funded property amounted to £81,000. During the past year 64 lectures and 19 evening discourses have been delivered.

DURING the months of June and July the series of lectures on botany, by Mr. T. G. Baker, F.R.S., given at Chelsea, under the auspices of the Society of Apothecaries, will be continued. They are specially designed for medical students.

TWO lady students, we are informed, have been successful in taking the highest degree in connection with the examination in descriptive and practical anatomy, held by the Royal Irish College of Surgeons.

THE sand-grouse has appeared again, a large flock of this bird having been seen near Wicken, in Cambridgeshire.

MR. T. MELLARD READE, in a communication to the *Philosophical Magazine*, returns to his interesting physical speculations on the effects of contraction during the cooling of intrusive masses of granite, and shows that some hints of the operations of nature may be obtained from the processes of the ironfounder. In casting a large sphere, the centre is kept fed with new molten metal as the mass cools, in order to prevent the "honeycombing" of the central part. In intrusive masses of granite the absorption of the surrounding rock is often plainly to be seen in contact sections, where there is generally a laminated gneissic band between the granite and the enclosing rock. Mr. Reade suggests that fragments of gneissic rock found in granite may be broken off from the walls of the intrusion. He also shows that the reason why granite masses do not always show signs of shrinkage is not because the masses do not shrink, but because throughout their history they are kept in a state of compression.

DR. C. RICKETTS has recently contributed to the *Geological Magazine* a series of papers on "Physical Changes in the Earth's Crust," in which he describes some interesting and practical experiments he has made regarding the effects of pressure on layers of sand, clay, &c. The layers, differently coloured, were placed horizontally in a wooden trough and a weight applied at the top, when the plastic clay, being pressed downwards, was curved into folds and miniature contortions, resembling, even down to minute details, those often produced by natural causes in the rocks.

THE number of deaths caused by lightning in England and Wales from 1852 to 1880, as recorded by the Registrar-General, amounted to 546. In consequence of their greater exposure, the inhabitants of rural districts suffer more from lightning than those of towns. Dwellers on the coast seem to have a greater chance of escape than those inland.

MR. RICHARD HARGREAVES, late chief assistant at Regent Road Library, Salford, has been appointed librarian of the new Reckett Free Library at Hull.

AT the Mount Morgan Gold Mine, near Dolgelly, the operations for the past twelve months have resulted in the treatment of 5,290 tons of quartz for an average yield of 1 oz. 18 dwt. per ton, valued at about £36,000. This speaks well for the revival of an old Welsh mining industry.

A PROPOSAL is on foot to extend the new technical school as Huddersfield, which was opened in 1884. In 1887-8 the number of students reached 2,137. The accommodation provided falls short of the requirements of the school, and an extension at an early date is necessary. This will, probably, take the form of a continuation of the north wing of the school, to include new lecture rooms, a weaving room, reading room, and library. The cost is estimated at £4,500 (exclusive of furnishing), and an effort is being made to raise that amount by subscriptions.

ON the banks of the River Wey, at Alton, the remains of a large-sized beaver have been discovered. Mr. Thomas, osteologist, of the British Museum, reports that they are in a sub-fossil state of preservation. Notwithstanding their antiquity, the orange colouring on the front enamel of the teeth is remarkably well preserved.

A LARGE hoard of hidden treasure was lately discovered in the Island of Burrar, Orkney, whilst cutting peat for fuel. It consisted of coins of the eleventh century, together with a number of solid silver ornaments. This is not the first discovery of the kind which has been made in the Orkneys.

AN Act has been for some time in force in the Isle of Man with a view to the preservation of ancient monuments and historic relics found in the island. We do not know how this Act operates, but it would evidently not apply to pre-historic canoes, valuable though they may be from an archæological point of view. Mr. P. M. C. Kermode writes, in the newly-issued journal of the Manx Natural History and Antiquarian Society, *Yn Lioar Manninagh*, that one of these relics lies exposed to the sun and the frost, the wind and the rain, in an out-of-the-way farmyard. When last seen the grass was growing in its crevices, and the whole thing was being warped out of shape.

MR. J. C. STIVENS, Abbey Street, Chester, has just completed what is, in many respects, an unique collection of stuffed birds. The specimens number 1,500, and include nearly every variety of British game. Outside of a museum there are few private collections so extensive as this of Mr. Stivens, which is the result of many years' devotion to the study of ornithology.

GEOLOGISTS have long disagreed as to the rate at which the great cataract at Niagara has been worn backward by the combined influences of the stream and the weather. Sir Charles Lyell, in 1842, estimated the recession of the falls at one foot in a century. Professor Claypole is of opinion that Mr. Bakewell's estimate of three feet per century is more nearly accurate. The effects of the great storm at the beginning of the present year have quite altered the familiar contour of the falls, the change being from that of an angle at the vortex to the original horse-shoe shape. Several massive pieces of rock have fallen away from the precipice, causing vibrations resembling those of an earthquake.

AN ACOUSTIC RANGE FINDER.—*Industries* mentions that "Captain Thouvenin, of the French army, has devised an instrument which he calls the "phonetélémètre," and which is intended to be used in estimating distances from the time taken by sound to travel. The instrument consists essentially in a stop watch, fitted with a second dial at the back, which dial is marked in kilometres and seconds. In addition, there is a measuring wheel at the rim of the watch, connected with a separate hand or index. The front dial contains distances marked on two concentric circles from 1 to 20 kilometres and 1 to 15 kilometres, which correspond to the two ordnance maps of France drawn to scales of 1 in 100,000 and 1 in 80,000 respectively. To ascertain the distance from the map, it is only necessary to set the index to zero, and run the measuring wheel along the route on the map between the two points the distance of which is required. The distance can then be read off on the front dial. For purposes of orientation a small compass is put into the winding knob of the watch. To use the watch for ascertaining the distance by sound, the second hand is started at the moment when the flash of a gun is seen, and is stopped when the sound reaches the observer. He can then read off the distance in kilometres, and fractions of a kilometre, on the back dial of the watch. We may mention that exactly the same principle was employed some time ago by Mr. Trotter in his chronograph dial, a description of which will be found in our issue of January 6, 1888."

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Some valuable deposits of petroleum have been discovered by Mr. A. Tocchi in South Australia, near Yorketown, the country at the extremity of Yorke Peninsula, lying between Spencer Gulf and Gulf St. Vincent.

The next meeting of the American Society of Microscopists will be held in Buffalo, from August 20th to 23rd.

Mrs. Stowell, who, in the University of Michigan, has done excellent work in microscopy, has been appointed Special Microscopic Artist to the Botanical Department at Washington, at a salary of £200 per annum.

Sir H. E. Roscoe, M.P., F.R.S., delivered his presidential address to the Wednesbury Literary Institute, taking as his subject "Metal from Clay," illustrated by experiments showing the new method of making aluminium.

Mr. J. D. Ellis, of the Atlas Works, Sheffield, is the recipient of the Bessemer Gold Medal for 1889, given by the Iron and Steel Institute.

The Manchester Technical School reports that the number of students on May 6th was 3,228, against 2,801 last year, being an increase of 427.

The Royal Commission appointed to inquire into the question of the extension of powers of the University of London for the advancement of higher education, recommends that the constitution of that body should be remodelled, and a new charter should be applied for, giving the university full teaching powers, as well as continuing the examining privileges which it possesses at present. In the event of such charter being obtained, the commissioners recommend that no other university be now established in London, and that the petition of University College and King's College be not granted. It will be seen that the object is to unite the functions of a teaching, as well as an examining, university in one institution.

During the summer months classes will be held, in connection with the "Liverpool Science and Art Classes," for field-work in geology, at the following centres:—Liverpool, Bootle, and Egremont. The teacher is Mr. D. Clague, F.G.S. (Queen's medallist), and each course will be opened by an introductory address, entitled "Local Geology: How to Study It." A class in practical botany will also be held in Ashton Chambers, Hackin's Hey, Liverpool, conducted by Mr. H. Leaton Edwards, F.I.C. The lessons given will be of an elementary character, no previous knowledge of botany being assumed. Meetings in the Botanic Gardens, and other out-of-door excursions, will be arranged from time to time.

Our attention has been called to an error which crept into our "Note in Brief" of last month on the subject of the proposed admission of women as Fellows of the Geological Society. We regret the error, and now state that the proposal was brought before a special general meeting of Fellows, and only lost by four votes, the figures being 29 for and 33 against the motion.

The members of the Manchester Branch of the Teachers' Guild of Great Britain and Ireland closed their first session on May 22nd, with an evening meeting in the Royal Botanical Gardens, Old Trafford, when they went through the greenhouses and grounds under the able guidance of Mr. Leo H. Grindon, who pleasantly described the flowers, plants, and trees. The President of this branch, Professor Wilkins, stated that the first year of the Guild had been a great success.

Budding, and the Formation of Colonies amongst Animals.*

By W. A. Herdman, D.Sc, F.L.S., *Professor of Natural History in University College, Liverpool.*

There are two kinds of reproduction found amongst animals, the sexual and the asexual, and one of the commonest forms of the latter is budding, or gemmation. When the buds produced do not become detached the result is the formation of a colony, and such compound animals are found in many groups, from the Protozoa upwards to the Vertebrata. The bud is in every case an outgrowth from or partially detached piece of the body of the parent animal, and it is interesting to observe that in reviewing the various groups, as the structure of the adult body becomes more complex the bud also becomes more elaborate, both in its origin and its development; so that we may formulate the generalization that a bud, in the case of any group, contains representatives of all the more important parts of the parent's body. Some important discoveries have lately been made in the case of the highest group of animals in which budding occurs, viz., the Tunicata, which support the above statement, and I shall lead up to an account of them by briefly recapitulating the phenomena of budding in the various lower groups in which it is found.

In a typical Protozoon, such as *Amœba*, the simple asexual reproduction or division which occurs is merely the result of increase in size consequent upon nutrition. The *Amœba* is a single cell which grows larger by the formation of new protoplasm when it is supplied with food. When a certain limit is reached, probably because any further growth would reduce too much the relation of the surface (through which all interchange with the external world takes place) to the mass, the protoplasm, after certain preliminary changes in its central part, the nucleus, becomes divided into two pieces which are exactly alike in essential composition, and which go their ways as independent *Amœbæ*. Here, then, the young animals are evidently similar in structure to the parent and are parts of its body, since the parent simply divided to form the offspring. In this case no colony is produced, because the two young animals do not remain attached together; but in other Protozoa, such as the genus *Dendrosoma* amongst the Tentaculiferous Infusoria, true colonies are formed as the result of gemmation, and in all these cases the new animals are formed of a part of the simple protoplasm of the animals previously present in the colony.

Turning now to the Metazoa, we shall pass over the sponges, where the processes of budding and of growth are so interwoven that it is difficult to distinguish between them, and come at once to *Hydra*, the well-known type of the lower Cœlenterata.

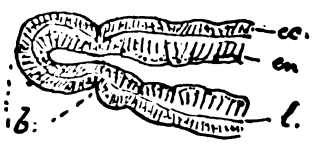

Fig. 1.

Part of a transverse section through the body of *Hydra* and a young bud. *ec.* Ectoderm. *en.* Endoderm. *l.* Supporting lamella. *b.* Bud.

In a *Hydra* under favourable conditions gemmation is the commoner method of reproduction, and the bud is formed as a small projection from the side of the body of the parent (see *fig.* 1). The projection rapidly elongates, acquires a terminal mouth opening and tentacles, and may then either be detached as an independent *Hydra* or remain fixed and produce buds in its turn, thus forming a temporary colony.

Hydra, being a metazoon, is formed of many cells, which are arranged so as to form two important layers—an outer, the ectoderm, and an

*An Address delivered before the Liverpool Microscopical Society on May 3rd, 1889.

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inner, the endoderm, separated by a structureless membrane (*fig. 1, l*), and, together, forming the wall of a large central cavity, the enteron, which communicates with the exterior only through the mouth. The young bud arises as a simple pushing out of this body wall, and is consequently formed of ectoderm and endoderm cells, with a cavity inside continuous with the enteron of the parent (see *fig. 1*). The bud is thus clearly a part of the parent's body, and is formed of representatives of the two important parts or primary layers of which that body is composed. It is the same in the case of the numerous Hydroid colonies commonly known as Zoophytes. In *Cordylophora*, for example, each member of the colony has essentially the structure of a *Hydra*, and each new bud that appears is formed of a prolongation from the ectoderm and endoderm of one of the members of the colony.

In the higher Cœlenterata, and Metazoa above this, a third layer, the mesoderm, derived in the embryo from the ectoderm or from the endoderm, or partly from the one and partly from the other, is formed in the body. In the sea-anemones this layer is found of considerable thickness, but only a few sea-anemones produce colonies. In *Sarcodictyon*, however, and in *Alcyonium*, and in the true corals, which are practically colonies of sea-anemone-like animals (the polypes), the buds are formed of prolongations of all three layers of the body—the ectoderm, the mesoderm, and the endoderm. This is most distinctly seen, perhaps, in *Sarcodictyon*, where the members of the colony are united by a flat

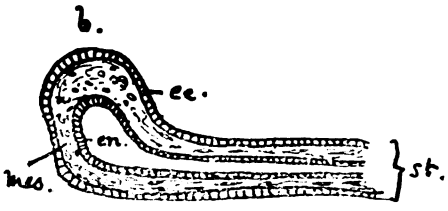

FIG. 2.

Diagrammatic longitudinal section through the stolon and bud of *Sarcodictyon*. *st.* Stolon. *b.* Bud. *ec.* Ectoderm. *en.* Endoderm. *mes.* Mesoderm.

band (the stolon), which is found creeping over the surface of stones and shells, and from the free ends of which the buds are produced as upgrowths (see *fig. 2*). Now this stolon, like the polypes, is covered by a layer of ectoderm, under which is mesoderm, while the central cavity of the stolon is lined by endoderm. So that all these important parts of the body of the adult are represented in any outgrowth of the stolon which forms a bud (*fig. 2, b*).

Above the Cœlenterata the Metazoa consist of a main stock, the series of worms, from which various other smaller and larger groups have been derived at different times. Amongst these the more highly-organized groups do not exhibit gemmation and the formation of colonies, but some of the more lowly-developed worms do, and there are two sets of degenerate animals—the one a remarkably modified offshoot from the worms, the Polyzoa, and the other the lowest section of the Vertebrata, the Ascidians, both of which show colonies produced by gemmation.

In the Polyzoa, until a few years ago, there was great difference of opinion amongst the leading authorities as to the origin and structure of the buds, some investigators deriving them from ectodermal tissues, and others from mesodermal, while neither view included endodermal elements. Professor Haddon, however, in 1883,* attempted to reconcile these conflicting ideas, and showed that it is highly probable that in all sections of the Polyzoa the buds contain cells derived from the endoderm as well as from the mesoderm and ectoderm of the parent, and that these cells develope into the corresponding tissues in the young polypite.

In the Tunicata, the lowest group of the Chordata, and closely related to the true Vertebrata, we meet with some forms which bud and produce colonies, while others remain simple. We may divide the class Tunicata into three orders:—the Larvacea, the Thaliacea, and the Ascidiacea. The Larvacea are small, free-swimming, solitary forms (such as *Appendicularia*) which do not bud. They resemble the larval forms of most other Tunicata in having a notochord in the tail.

The Thaliacea include the well-known pelagic *Salpa* and *Doliolum*, and their relations. They have a more or less complicated alternation of generations in their life history, and at one stage reproduce by budding so as to form a free-swimming colony.

The Ascidiacea are the more typical Ascidians, and may be divided into three sub-orders:—

I. The Ascidiæ Salpiformes, including *Pyrosoma*, a free-swimming colony in the form of a hollow cylinder closed at one end;

II. The Ascidiæ Simplices, the solitary or simple fixed Ascidians, which rarely bud; and

III. The Ascidiæ Compositæ, the compound fixed Ascidians, which always bud and form typical colonies.

These three sections have interesting relations to one another, as I have shown in my *Challenger* Report.†

1. That the Ascidiæ Salpiformes are merely a somewhat modified offshoot from the Compound Ascidians.

2. That the gap between the Simple and the Compound Ascidians is bridged over by a series of intermediate forms, the so-called "Social Ascidians."

3. That the Compound Ascidians are an artificial or "polyphyletic" assemblage, being composed of several independent groups which have been derived at different times from the Simple Ascidians, and have separately acquired the property of budding to form colonies.

As a type of the Simple Ascidians may be taken the genus *Ascidia*,‡ which has a cartilaginous test outside the ectoderm, in which ramify prolongations from the body wall containing vascular tubes, each divided by a median partition. These double tubes are very similar in appearance and structure to those found in the stolons of the Social and some Compound Ascidians.

In the "Social" Ascidians *Clavelina* and *Perophora* (which, however, I place in the Ascidiæ Simplices) there are small colonies in which

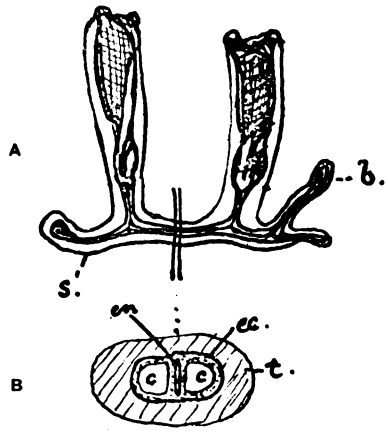

FIG. 3.

A. Small colony of *Clavelina*, showing the stolon, *s*, and buds, *b*.

B. Transverse section of the stolon magnified. *t.* The test. *c, c.* The cavities in which the blood flows. *ec.* Ectoderm. *en.* Endoderm.

the members are united by their posterior ends to a slender creeping stolon, from the ends of which buds grow out and develope into new Ascidians (*fig. 3*, A, *b*). The stolons contain vascular tubes, each of

* "On Budding in the Polyzoa," *Quart. Journ. Micros. Sc.*, vol. xxiii.

† *Zool. Chall. Exped.* Report on Tunicata, part i., 1882; part ii., 1886; part iii., 1888.

‡ Here a short account of the anatomy of *Ascidia* was given, such as may be found in the article "Tunicata," in the *Ency. Brit.*, 9th ed., or in *Trans. Manchester Micros. Soc.*, for 1887.

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which is divided along its length by a double partition; or, in other words, a flattened inner tube (the double partition) is attached to the opposite walls of the outer tube, so as to separate two streams of blood flowing in different directions (see *fig. 3*, B, *c*, *c*.)

In the Compound Ascidians the colonies are formed of groups of small Ascidians closely united together and buried in a common cartilaginous investing mass, in which there either may (*Botryllus*) or may not be ramifying vascular tubes, with the usual hollow partitions. The members of the colony, or ascidiozooids, differ considerably in the various families in their shape, structure, and mode of origin as buds. We shall take as a type *Amaroucium*, a genus belonging to the family Polyclinidæ (see *fig. 4*). Here the body of the ascidiozooid is long, and is divided into three regions, the thorax in front occupied chiefly by the branchial sac, then the abdomen containing the greater part of the alimentary canal, and finally a long, slender region, the post-abdomen, composed of a divided vascular tube, the partition being itself a flattened tube (*fig. 4*, B.). The post-abdomen contains also the reproductive organs, and its end is occupied by the curved heart, each extremity of which communicates with one of the vascular tubes above (*fig. 4*, A, *h*).

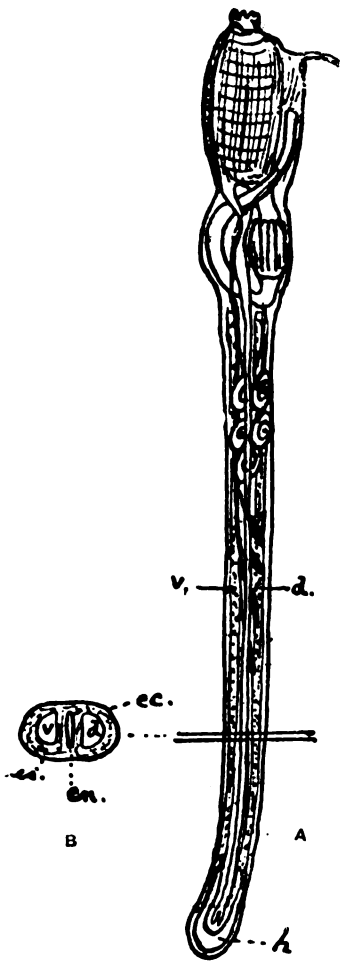


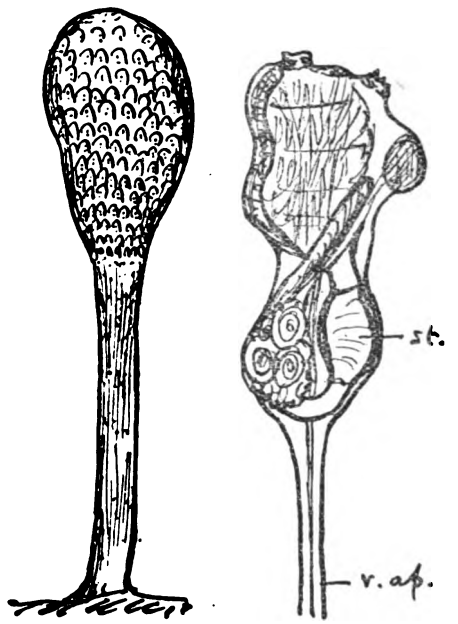
FIG. 4.

A. An ascidiozooid from a colony of *Amaroucium*. *h*. Heart. *v*, *d*. Ventral and dorsal tubes of the post-abdomen.

B. Transverse section of the post-abdomen, *ec*. Ectoderm. *en*. Endoderm. *mes*. Mesoderm.

Kowalevsky,* in 1874, showed that in *Amaroucium* budding is performed by the post-abdomen elongating, and then becoming segmented into several pieces, each of which grows into a young ascidiozooid. Hence it is evident that here, as in *Clavelina*, the bud is formed from part of a vascular tube covered by ectoderm, and containing a double partition. (Compare *figs. 3* and *4*).

In examining the *Challenger* Compound Ascidians, I found that in *Colella*† (a member of the family Distomidæ), where there is no proper post-abdomen, each ascidiozooid is provided with a long, slender appendage in the form of the usual divided vascular tube; and that these long vascular prolongations extend downwards from the upper wide part of the colony in which the ascidiozooids are placed into the slender supporting stalk (see *fig. 5*). I also found that the buds in this form are produced as outgrowths from these vascular tubes far down the stalk, and that they gradually work their way upwards, as a result of the growth of the stalk until they come to take their places as young ascidiozooids at the base of the upper part of the colony.



A FIG. 5. B

A. Colony of *Colella*, natural size.

B. An ascidiozooid of *Colella*, enlarged. *st*. Stomach. *v. ap*.. Vascular appendage (gemmiparous stolon).

As I pointed out in the *Challenger* Report, we have here, as in some of the other known cases of budding amongst Ascidians, the bud formed of an ectodermal coating surrounding a segment of a vascular partitioned tube, which was then supposed to be wholly mesodermal in its nature, and I could only account for the endodermal element in the bud by suggesting that possibly there might be endoderm cells amongst the undifferentiated blood corpuscles. Since then E. van Beneden and C. Julin, in their admirable *Recherches sur la Morphologie des Tuniciers*,* have shown that the flattened tube forming the double partition in the stolon of *Clavelina* (see *fig. 3*, B) is a structure which they call the "epicardium," and which is endodermal in its origin, being a prolongation from the posterior end of the branchial sac. Consequently as this structure is a prolongation from the alimentary canal of the parent, it is very natural that the alimentary canal of the bud should be developed from it.

Maurice † has lately shown that the dorsal and ventral vascular tubes in the post-abdomen of such a compound Ascidian as *Amaroucium* (*fig. 4*, *d* and *v*) are prolongations of the pericardial cavity into which the posteriorly placed fusiform heart opens freely, while the central flattened tube or double partition is the epicardium (*fig. 4*, B, *en*), and opens anteriorly into the branchial sac, either in the adult or in the larval condition; that is, that these important parts of the post-abdomen are the same things as the similar structures in the stolon of *Clavelina*, and have the same important relations to the production of buds; and there can be no doubt that in the case of *Colella* also (see *fig. 5*, B), the vascular appendage is formed of a central epicardial tube with a pair of laterally placed pericardial prolongations, and that the epicardial tube, being endodermal in origin, supplies that important element to the bud. Consequently the stolon of *Clavelina*, the vascular appendage of *Colella*, and the post-abdomen of *Amaroucium* may all alike be regarded as

* *Ueber die Knospung der Ascidien, Archiv für mikros. Anat.*, t. x., p. 441.

† *Zool. Chall. Exped.* Report on the Tunicata, part ii., p. 74, 94; 1885.

* *Archives de Biologie*, t. vi., p. 237; 1886.

† *Étude monographique d'une espèce d Ascidie Composée. Archives de Biologie*, t. viii., fasc. II., p. 205. 1888.

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gemmiparous stolons* formed of the three important germ layers of the parent, and giving rise to the corresponding layers in the offspring.

This general conclusion in regard to the origin of buds is one of wide application. It probably holds good for all cases of budding, of the formation of colonies, throughout the whole animal kingdom. And I should like to point out to you that this generalization, of first-rate importance, has been arrived at by the independent observations of a number of different specialists, each working at his own animal or little group of animals. The budding of *Hydra* has been long known. The nature of the process in the Polyzoa was elucidated by Haddon. Several investigators have added successive steps in solving the problem of gemmation in the Tunicata. Kowalevsky observed the formation of buds by the segmentation of the post-abdomen in *Amaroucium*, van Beneden and Julin discovered the endodermal origin of the partition in the stolon of *Clavelina*, and Maurice finally applied the results of van Beneden and Julin to the observations of Kowalevsky, and so enabled us to bring the Tunicata into line with the other cases of gemmation, and formulate our generalization that all the germ layers of an animal's body enter into the formation of its bud, and give rise in the young animal to corresponding parts to those from which they were derived in the parent.

Economic Entomology:

Insects in Relation to Agriculture.†

By E. D. Fish.

ECONOMIC entomology, the modern expression for that part of the science generally spoken of as the "utilitarian," is a study of very recent date. The study of insect life must have forced itself on the attention of mankind from its earliest history; but it was the beginning of the 16th century before any practical work was published, and it was not until the appearance of Ray's *Historia Insectorum*, in 1710, and the *Systema Naturæ*, of Linnæus, 1735, that a scientific classification was attempted. The latter was, and is, perhaps, to this day, the best and most authoritative work ever published. Many other works of no mean authority have since appeared, all adding much to our store of knowledge of insect life, without attempting anything like a scientific study of the economic side of the question. The nearest approach is the question of fertilisation of plants by insects, which has been under consideration and noted since 1787, though Darwin was the first to propound anything like a scientific theory, that of adaptation of insects to plants and plants to insects, and their mutual dependence upon each other. Referring to injurious insects, perhaps Kirby and Spence, in their *Introduction*, were about the first to treat of them to any extent, and then only by naming the principal insects then known to be injurious to plants and animals. Following in the same line we have Curtis on garden and farm pests. In our own day the most notable and practical economic entomologist is Miss E. A. Ormerod. This good lady some years ago was so impressed with the serious losses sustained by the farmers, that she resolved upon devoting her life, and I believe also her purse, to the study of injurious insects, and the alleviation of the farmers with regard to them. Mr. Charles Whitehead, of the Government Agricultural Department, and Mr. Mousley, of Huddersfield, are both ably following up the work with Miss Ormerod and doing excellent work. However, with all due respect to them personally and to their efforts, there is one point to which I must take exception, that is, to classify most insects, including many of the Lepidoptera, as injurious. To a certain extent all Lepidoptera *are* injurious, inasmuch as the larvæ are vegetable feeders; but no reference is made, or the possibility hinted at, that the imago, or perfect insect may be, and undoubtedly is, valuable or *indispensable* to the propagation of some other plants or vegetables by cross-fertilisation, in the ordinary course of procuring their food, which consists of nectar. Careful distinction must also be made between what are known as injurious insects and parasites. Of the latter we have upwards of a thousand known species in this country, all parasites to other insects, and I have known many instances in which farmers and others have destroyed these creatures by thousands, mistaking them for the insects doing damage to their crops.

The number of insects known to be directly injurious to plants and animals is so large that it would be impossible in an article of this description even to name them. It is equally impossible to estimate the losses sustained by the farmers and the nation, but it amounts to many millions sterling, as a few instances will readily show. Miss Ormerod reports that the loss by cattle alone, through the warble fly (*Hypoderma Bovis*), amounted to between three and four millions sterling per annum. This fly deposits its eggs in the skin of the cow, generally along the back. The larvæ when hatched feeds upon the fatty or fleshy part of the animal until it attains about an inch in length before changing into the pupæ stage, the perfect insect afterwards making its escape through the skin. The suffering of cattle from this cause may best be imagined when I mention the fact that "hides were exhibited at the Royal Agricultural Society's show, in 1887, of cattle which had died, consequent on the presence in them of more than *four hundred* warbles." Horses are also subject to the attack of warbles, but not to the same extent as the cow; but this may be accounted for by the fact that the horse is better cared for and groomed, and is constantly under the care of man. *Œstrus equi* is a much more serious pest, as its eggs, which are covered with a glutinous substance, adhere to the hair, and are deposited on such parts of the body which the horse can lick with his tongue, and thus conveys them to its stomach, where the eggs are hatched and the young larvæ matured. *Œstrus hæmorrhoidalis*, another of a similar species, deposits its eggs on the lips of the horse, and are likewise conveyed internally. It may well be imagined, without entering into details, the sufferings of the horse, consequent sickness, inflammation, and death. Sheep suffer from *Œstrus ovis*, or sheep-nostril fly. The eggs are deposited in the nostrils of the sheep, and the larvæ work their way up into the head, where they remain until about an inch in length, when they make their way down the nostril again and fall to the ground, where they change into the pupæ state. In addition to the insects named, many others infest sheep, horses, cattle, and live stock of every description in various ways, which are the cause of the death of many hundreds throughout the country, each of which are a direct and serious loss to their owners.

It would fill volumes to attempt anything like a detailed description of each crop and its specific enemies. I must, therefore, briefly refer to some of the principal crops and their enemies. The *Tipulæ* (Daddy Long-legs), *Paludosa* (marsh crane-fly), and *Maculosa* (spotted crane-fly), are among the most troublesome and destructive insects agriculturalists have to contend against. Some years they are exceedingly abundant, especially after a season of much rain and moisture. The larvæ is a root-feeder, and generally commences its destructive work very early in the spring, grass lands and autumn-sown wheat being the first to suffer, though they follow up their destructive work to the end of August if the season continues favourable. No root crops of almost any description is safe from their ravages. From all parts of the country reports are returned of thousands of acres of crops of various kinds being destroyed by them. Next to the *Tipulæ* must be placed the wire-worms, *Elator Lineatus*, *E. Obscurus*, *E. Sputator*, and *E.*

* And I may probably add the vessels ramifying in the test of *Sarcobotrylloides Wyvillii*, in connection with which I found buds (see *Challenger* Report on Tunicata, part II., p. 59); and the vascular prolongations from the bodies of the ascidiozooids in *Goodsiria coccinea*, which show a central and two lateral tubes in transverse section.

† Read at a Meeting of the Liverpool Science Students' Association, held March 29th, 1889.

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Ruficandis. These are troublesome creatures, as the larvæ are very hard and difficult to kill, and live in this condition for about three years. Their favourite foods are mangolds and potatoes, but corn and almost any other crops do not escape them. As an example of what individual farmers may suffer, one of Miss Ormerod's correspondents writes:—"The extent of injury and money loss from wire-worm may be difficult to assess, but on my farm of 1,000 acres I do not think I shall be far wrong if I value the loss on 350 acres of corn on an average of seasons at not less than £2 per acre, or £700 per annum." Another estimates his loss on 15 acres at £186. *Cephus Pygmæus*, or corn saw-fly, is also very destructive. This fly punctures a hole in the stem of the corn, in which its eggs are deposited; the young larvæ feed on the inside, and when about to change into the pupæ cuts its way out, generally at a point near the ground, which causes the grain to fall. *Cecidomyia tritici*, or wheat midge, on the contrary, attacks the wheat in flower. It is very small, measuring about an eighth of an inch in expanse, deposits about a dozen eggs in the flower, and the larvæ complete the destruction. *Aphis Granaria*, like all its tribe, is also very destructive. It commences its work early in the spring by attacking the leaves and stems of the plants, and continues until the corn is in the ear, at times completely checking all growth. *Thrip Cerealium*, though barely the twelfth of an inch in length, is at times so abundant as to ruin the whole crop attacked by it. While on the question of grain, some reference to the Hessian Fly (*Cecidomyia destructor*) may be expected. I am strongly of opinion, however, we have little to fear as to its ever permanently establishing itself in this country. It has been known in America since 1776, and, of course, is said by the Americans to have been imported into that country in straw brought by the Hessian troops. All reliable authorities state that the fly was not known in Germany and Austria until 1833; France and Italy, 1834; and Russia until 1836. It is double brooded in America, but we have no evidence of its having been so in this country, which leads to the conclusion that those which found their way here have been introduced in the pupæ form (known as flax seeds). It is a most difficult problem, and, in the vast majority of instances, an impossibility to introduce and acclimatise insects from one country, or even from one district, to another.

Two of the most important crops to the farmers of this country are turnips and mangolds, and few things are more subject to attack, or have more enemies in the insect world, the principal of which are *Phyllotreta Undulata* (turnip-fly), *Athalia Spinarum* (saw-fly), *Ceutorhynchus Contractus* (weevil), *Ceutorhynchus Sulcicollis* (gall-fly), *Aphis Rapae* (aphis), *Agrotis Segetum* (turnip moth), and several of their allied species. Nearly all these, except the turnip-moth and the gall, commence their attack upon the young plants almost as soon as they appear above the ground, and being so minute and active they almost escape observation until the mischief is done. 1881 was, perhaps, the worst year ever known for these pests. The following figures, from Miss Ormerod's report, will best explain the destructive character of these creatures, and what it means to the farmers and to the country. The acreage under turnips, according to the returns to the Government, from 22 English and 11 Scotch counties, was 1,344,173 acres, and the money value to £1,250,480. This sum is calculated on the basis that only about half of the above crops was lost, which brings it to an average of slightly under £2 per acre. That this was a very low estimate is shown by another table, taking a typical case as an average example, where the money loss on 97 acres is given at £320, or about £3 16s per acre; other estimates go as high as £7 per acre, according to the description of turnips. Peas have their enemies in *Sitona Critina* and *S. Lineata*, and beans by *Aphis rumicis*. Some years these insects are so abundant as to destroy the whole crop. Celery has *Tephrotes onopordinis*. Carrots, *Psila rosa*. Onions, *Anthomyia cepurum*, with others of a similarly destructive character. The fruit garden shares the same fate as the field crops. It is a common expression in the spring time, when there is a good show of flowers on the apple and pear trees, that should there be no frost or destructive winds it would be a good year for such fruits. It does not follow, because the absence of frost and winds encourages other enemies equally destructive, such as *Anthonomus pomorum*, a weevil, the eggs of which are deposited in the flower, and which soon destroys them. *Carpocapsa pomonance*, or codling moth, like the weevil, deposits its eggs in the flower, with the result that the larvæ are hatched when the fruit is about to form, which causes it to fall before ripe. *Schizoneura Lanigera*, known as American blight, is destructive to the woody parts of the tree. The beautiful little moth *Hyponomeuta Padella* is frequently very abundant and destructive as a leaf-feeder. Fruit trees of every description have their special enemies, and suffer in the same manner as the apple and pear, causing very serious losses, more especially in the southern counties, where fruit is more extensively cultivated. Hops are worth a passing note, being an important crop to the people as well as the growers. The aphis is perhaps the most destructive insect, though they are subject to attack by several other species. In a recent number of the *Wesley Naturalist, or Scientific Journal*, Mr. Geo. Chaloner, F.C.S., states that "such is the power wielded by these small insects (aphis), that their presence or absence in the hop fields of Britain has influenced the amount of hop duty to the extent of some hundred thousand pounds in a single year." This, of course, was prior to 1862, when the hop duty was repealed, but as the duty payable to the Government by the grower averaged from 1d. to 1½d. per lb., some idea may be formed of the losses sustained. Now, as every variety of tree, shrub, and plant has not only its special insect, but in many instances several feeling upon it, I can only leave it to the imagination the vast amount of destruction which is continually going on, and the vast importance of the question, not only to the agriculturalist, but to the country and to every member of the community. Great discrimination, however, is necessary when we come to deal with the remedies against these destructive creatures. Those I have named are purely parasitic to plants and animals, while these in their turn have other insects parasitic to them. Most of the Lepidoptera are necessary to plants as fertilisers, and the vast majority of Coleoptera are beneficial and almost necessary to our own existence as scavengers. Many instances might be given of insects parasitical to another of a very destructive character, being destroyed by people simply because their habits have exposed them to view, while the habits of the destructive creature have tended in the other direction to concealment and escape.

As most of the destruction caused by insects is through preventible causes, the question is, What must be done to remedy this condition of things? A great deal must be set down to our ignorance and neglect of a subject of so vast importance. Climatic influences have a considerable bearing upon the question, yet, in this, which one might naturally expect should be understood, we find opinions still prevailing, not only amongst farmers and the general public, but frequently by the Press, which are quite opposite to facts, viz., that frost and snow are destructive to insect life, the opposite being a well-confirmed fact that both frost and snow are great *preservatives* of insect life. The severest colds of our winter, or the fact that the eggs or larvæ of insects are embedded in ice or snow for months, will not destroy them. On the other hand, a wet and open winter is terribly fatal to them by producing a fungoid growth, which is a fatal disease; besides, an open winter exposes them to the birds, who depend largely upon them for their winter's food. To remedy or improve the present condition of things more knowledge is wanted. Means should be adopted, not only to obtain but to disseminate information on the life-history and habits of all insects known to be injurious to animals or crops, and the best

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methods of treatment and cultivation of lands affected by them. Miss Ormerod, and a few others, are doing a noble work to assist in this matter, but a question of such vast importance to the State, as well as to the individual, might well be taken up by the Agricultural Department of the Government, under properly qualified individuals, not only to collect information and statistics, but to assist in the dissemination of knowledge among the farmers and in schools of the country districts by the establishment of classes, after the model of science classes in our towns. The present methods adopted for the destruction of insects are of an antiquated and very partial character. Strong measures of extermination, as far as possible, should be adopted in any known district where the pest has become troublesome, very much after the manner as they deal with districts affected by cattle disease. Unfortunately, at present the laws or conditions under which many farmers hold their lands are against their freedom of action in the choice of crops or the treatment of the land to enable them to get rid of many of the pests, which might be done without any direct loss to the farmers; for instance, if in any district the turnip-fly was prevalent, such crops might be sown for a season or so as would deprive this particular insect of its natural food, and so exterminate it at least for a considerable time. Such action, however, would not have to be taken by any one farmer alone, or all his efforts would fail; it must be done by the joint action of his neighbours in the same district. However practical one farmer might be, or however effectually he may have exterminated any pest from his own land, his efforts must fail if his neighbour on the opposite side of the hedge insisted upon sowing, or be compelled by the terms with his landlord to sow such crops as would encourage the pest.

Observations on the Unusual Abundance in 1888 of the Madder Hawk Moth *(Deilephila galii).**

By J. W. Ellis, M.B. Vic., F.E.S.

JUST as particular years remain in the memory of the agriculturist as years of plenty or of scarcity of the crops in which he is interested, so the calendar of the British entomologist contains red-letter years—remembered by him as years either of remarkable scarcity of insects generally, or of unusual abundance of some particular species, which, under ordinary circumstances, is but a casual visitor to our islands, or which, if it has a home here at all, has that habitation in very restricted localities. Such are the various "edusa" years, "antiopa" years, and "convolvuli" years, from the exceptional abundance of the clouded yellow (*Colias Edusa*) or Camberwell beauty (*Vanessa Antiopa*) butterflies, or the convolvulus hawk moth (*Sphinx convolvuli*).

Such a year, too, has just passed, and 1888 will be remembered by the present generation of British lepidopterists as the "galii" year, for never before in the entomological history of our island has the madder hawk moth occurred in such wide spread abundance—from Aberdeen to the south coast, and from Ireland to Suffolk. Generally a common species on the Continent of Europe, *Deilephila galii* is only of casual occurrence in Britain, except on the long stretch of sand-hills which skirts the coast of Kent for some miles south of Deal, and where scarcely a year passes but one or two, or half-a-dozen, of the larvæ are met with. During the year 1859 the moth was taken occasionally throughout England, but not, I think, in Scotland or the sister island; and, again, the year 1870 was remarkable for the number of captures of this insect throughout the greater part of Britain. At this time, although only very few specimens of the moth itself were captured in the neighbourhood of Liverpool, the caterpillars were collected in some numbers on the Wallasey sand-hills, and the collection of Mr. S. J. Capper and that bequeathed to this city by the late Nicholas Cooke contain full series bred from larvæ obtained there during that year. Since 1870 eighteen years elapsed with scarcely a record of any captures of *Deilephila galii*, or its larva, except about Deal, until the entomological periodicals of last August and September announced the fact that the species was again abundant—even more abundant than had ever been the case formerly.*

Deilephila galii belongs to a family of lepidopterous insects, the Sphingidæ, which is characterised by the long, narrow, and pointed wings in the typical species, a character which indicates capability for rapid and long-continued flight. Their larvæ feed for the most part on shrubs and low plants, and are at once recognised from all other lepidopterous larvæ by possessing on the anal segment a long, re-curved, and often gaily-coloured horn—only absent in some aberrant genera. They feed during the latter part of summer, change to a pupa underground, in which condition they pass the winter and spring, and the perfect insect appears during the following summer. Being mostly of crepuscular habits, the perfect insects are usually observed during the twilight, hovering over flowers, from which, while poised upon the wing, they sip the nectar by means of an extremely elongated haustellum.

The following list of dates and localities will give some idea of the number and distribution of the captures of this moth during 1888—premising that this list does not contain, probably, one-fourth of the specimens that actually came into the possession of entomologists:—1888, July 16th, Howth (County Dublin); 17th, Aberdeen; 18th, Hartlepool; 20th, Hartlepool; 21st, Hest Bank (near Morecambe), Carlisle, and Derby; 22nd, Fleetwood; 23rd, Stoney-Stratford (Bucks) and Eton; 24th, St. Margaret's Bay (Kent)—seventeen specimens were taken here by two "brethren of the net" between this date and August 4th; 25th, Holloway; 26th, Harrogate; 27th, St. Anne's-on-the-Sea; 29th, Silvertown (Essex); August 2nd, Buckhurst Hill (Essex); 4th, Dundee and Dartford; and 8th, Folkestone. Two or three specimens were captured by Mr. F. Archer and his friends at Crosby, but these have not been recorded in entomological magazines.

The frequent occurrence of the moth caused a sharp look-out to be kept for the larvæ, which feed principally on the *Galium verum* (yellow bedstraw), though they will eat *Galium saxatile*, willow herb, and fuchsia. About the last week in August specimens of the larvæ were found, and from this time to the end of September the beautiful and conspicuous caterpillar was taken in abundance, not only in its old habitat, the Kentish coast sand-hills, but also at Wallasey; while a few occurred at Crosby and other places on the Lancashire coast, on the coasts of Essex and Suffolk, and occasionally inland. I computed, from what I knew of the success of local collectors, that there could not have been less than 500 specimens collected at Wallasey alone, while the Deal sand-hills must have produced thrice this number.

Now, whence came this abnormal supply of *Deilephila galii*? Were they British born and bred, or were they importations from the European continent? It has long been customary to explain such "outbreaks" of ordinarily scarce insects in Britain by supposing that they have migrated or have been "blown over" from the Continent. We know that some insects do travel enormous distances, both over sea and over land, and not only are these the more powerfully built *Locustidæ*—whose migrations are proverbial—but even swarms of butterflies have have been frequently met with, while the capture of a hawk moth or other strong-winged lepidopteron 100 or 200 miles from the land is so frequent as to occasion no surprise. I have myself a specimen of a large night-flying moth (*Erebus*) which was captured on board a ship on her passage out to Valparaiso when quite 300 miles from the mouth of the Rio de la Plata.

*A Paper read at a meeting of the Liverpool Biological Society, April 12th, 1889.

* It is a singular coincidence, as pointed out by a correspondent of *The Entomologist*, that the three years characterised by the abundance of *Deilephila galii* are also the three years during which the *Syrrhaptes paradoxus* (Pallas's sand grouse) has appeared in Britain.

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The Sphingidæ, too, have long and powerful wings, amply fitted for supra-marine passages; but yet this migration theory does not explain, in my opinion, the 1888 outbreak of *Deilephila galii*. Not only does it seem very improbable that a sufficiently-large number of these insects of both sexes should locate themselves at Wallasey, just the place where they were abundant eighteen years before (and there must have been a considerable number to account for the quantity of larvæ afterwards taken, although, strangely enough, not a specimen of the moth appears to have been recorded from this part of Cheshire), but also, it should be noted, that the first reported capture was made in Ireland; the next, the following day, at Aberdeen; then at Hartlepool, Carlisle, Morecambe, and Fleetwood; then at Derby, &c., &c., while not until eight days have elapsed since the first of these captures does the insect appear in that portion of our island nearest the European Continent.

Now, it is well known that some insects have the power of "laying over" in the pupal condition: lying dormant during the period proper for the emergence of the imago until the following, or it may be much later, season. Thus, of a single brood of *Eriogaster lanestris* reared under precisely similar conditions, some specimens will emerge the first year, some the second year, and so on, while some pupæ have been known to remain in this dormant condition until the eighth year. If this be the case under conditions of careful management in confinement, it is quite likely that even longer periods may be passed over before the emergence of the imago when exposed to the weather. It is not known, however, that any of the pupæ of the Sphingidæ so lay over, even for single years; but such a condition is very likely under certain circumstances to which the pupæ of insects inhabiting coast sand-hills are exposed. My friend Mr. C. S. Gregson, in course of conversation, has suggested that the changing conditions of our sand-hills is quite sufficient to account for many pupæ holding over—conditions which can only be appreciated by those who are accustomed to roam among such localities in search of insects or plants. As an illustration, I may remark that only a few days ago I found that during the past winter a large area of the Wallasey sand-hills, thickly covered with a luxuriant growth of *Rosa spinosissima*, on which the insect *Taniocampa opima* is most frequent, has become a sandy waste, scarcely recognisable through being covered with blown sand. Suppose that there are in this area—there maybe for ought I know pupæ of *Deilephila galii*, covered originally to a depth of two or three inches, but now, perhaps, with as many feet, how is it possible for such pupæ to receive the necessary amount of warmth from the sun for their proper maturation? And, so far as I know, such pupæ may lie dormant for an indefinite period—just as the seeds of plants may under similar circumstances—until another violent storm clears away the sand from this space of ground and again brings the pupæ to the surface, when they may develope, and give rise to another "outbreak" of *Deilephila galii*.

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The Ascent of Water in Plants and Trees.

By the Rev. Frank Ballard, M.A., B.Sc., F.R.M.S., &c.

Part II.

We have seen in former pages of this journal that Dr. Sachs does not rely solely upon his great name, but gives strong reasons for his views concerning the ascent of water in trees. These reasons are quite strong enough to remove any wonder that he is followed by so many. There is, however, a growing opinion that these reasons are, after all, open to criticism, and that the whole question cannot as yet be considered settled. The following brief statement of such opinions makes no pretension to originality, but as the criticism is mostly German and is not found in English, it may be interesting to some who are not familiar with that language :—

(1) To begin with, Haberlandt has pointed out that the extremely facile mobility (Verschiebarkeit) of the water of imbibition in the wood of cell walls, which forms the real basis of Sachs' theory, is, from a physical standpoint, very improbable.

The resistance due to friction has to be reckoned with, and seems decidedly too great to permit of such easy movement of water-molecules between the micellæ, or body molecules of the woody cell wall. It is to be noted that Sachs himself protests against capillarity as any valid explanation of the phenomena in question. But, in point of fact, the spaces between the micellæ are nothing else than a system of capillary tubes. Thus it appears to be a definite flaw in Sachs' theory that it assumes a total difference of physical constitution for the capillary system in one case to that in another. This would certainly require much more proof than is forthcoming. In addition to which, it may also be mentioned, though it cannot be here dwelt upon, that some special investigations of Nageli and Pfeffer into the condition of water in such organised bodies as are here contemplated, appear to lead to conclusions in direct conflict with the views of Sachs.

However, we may proceed to notice the special illustrations connected with Sachs' own statements, as given in these columns last month.

(2) Thus, in connexion with the difference existing between spring and autumn wood, a serious difficulty arises for his theory. He frankly acknowledges that the relatively thin-walled spring wood permits the transmission of water much more easily than the thick-walled autumn wood. Indeed, he speaks of the former as an "isolated" layer, by comparison. But this is in direct contradiction to the assumption that the water movement is in the cell walls. For in this case the channels of transmission would be manifestly greater for autumn than for spring. And there is no ground for assuming any qualitative difference between the constitution of the cell wall in the two cases. But, perhaps, some reply to this criticism might be found in the fact of the greater quantity of water, which has to pass upward, through necessities of transpiration, in spring as compared with autumn.

(3) Again: Sachs' experiments were carried on with wood, that is with a more or less complex body of tissue, not with cell walls *per se*. This prevents any sure conclusion as to the cell wall itself. Now, one of the experiments, upon which Sachs lays considerable stress, is in dealing with a cylinder of wood, cut smooth at both ends, and held vertically. When a drop of water is placed on the top it soon disappears, and a similar quantity appears on the lower section. But in regard to this very phenomenon, Von Höhnel claims to have determined, by direct observation of the plane of section, that in this case the water *only* moves in the *vessels*.

(4) In regard to Monocotyledons and Vascularia we have seen that, owing to the deficiency of Xylem proper in the Fibro-vascular bundles, Sachs is obliged to call in the help of the Sclerenchyma. But this is open to double objection. It is opposed both to anatomical considerations, and also to the physiological principle of the division of labour. It is, for example, well known that the arrangement of the Sclerenchyma skeleton is generally in accordance with the principles of mechanics. Thus it is compared by Strasburger and others with the girders, &c., of an iron bridge, and it appears to be definitely adapted to purposes of rigidity. Moreover, in some sharply-curving stems the continuity of this strengthening tissue is unquestionably broken. This fact would necessitate a further falling back upon the bast fibres,

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at places, for a fulfilment of the water-carrying function. But the only support that can be alleged for such a notion is a certain similarity between the bast cells and the woody fibres of Dicotyledons.

Further: Aroids possess no wood in the xylem portion of their vascular bundles, and in place of lignified Bast have Collenchyma fibres. This would seem to necessitate the passing on of the water-transmitting function to this tissue also.

Moreover, Russow has shown how Grasses transpire vigorously when they only possess a thin-walled, *non-lignified* tissue. These, and other such phenomena, are not covered by Sachs' generalisation.

(5) The experiment of sharply bending stems of flax, hop, &c., is not so conclusive as appears at first sight. Thus, as regards the actual closure of the lumina of the vessels, Russow asserts that he has proved that, however sharply the stem may be bent, even so far that the upper portion comes right over into contact with the lower, the lumina themselves of the lignified cells, regarded as vessels, only experience a gentle curvature, so that the conducting power for water is not at all destroyed.

Dufour, however, failed to press water through any such "nipped" twig, whence he concluded that Sachs was right. But Haberlandt replies that such conclusion is illogical in that it proceeds from experiments in an abnormal, injured condition to statements concerning an uninjured normal condition. It would certainly seem that all that can fairly be inferred, if Dufour were right—*i.e.*, if, with a nipped twig water did not pass through the cavities, and did pass through the wall-substance—would be that such conduction through the wall could take place under abnormal conditions. This is manifestly no fair basis for a general theory.

(6) Sachs insists that in undoubted instances of transpiration, the vessels are at the same time empty. Volkens combats this with the suggestion that this is not real emptiness, but only partial recession into the wood from the plane of section, owing to the rarefied condition of the air in the vessels, and the outer inwards pressure of the atmosphere when any tissue is cut through. Moreover, by using specially-constructed scissors which cut through at once two places distant only about 2 c.m., and examining a (dry) section of this, he asserts that the presence of water was fully shown in the vessels.

(7) If we take a careful survey of a longitudinal section of some twig, say of a transpiring plant, it seems somewhat unreasonable to shut up the whole of so important a function as water-transmission to one special tissue, especially when we remember that the presence of water is really necessary to the life of every cell. Thus, Godlewski believes that the medullary rays and the woody parenchyma take part in it, by means of the activity of their protoplasmic contents; acting like pumps by abstraction of water from a lower tracheid and passing it on to a higher one.

(8) Again, in regard to the cinnabar experiment, Elfving obtained some different results. By sucking some watery solution of eosin through wood of Taxus and other Conifers he found that the cell walls remained uncoloured, whilst their lumina were filled with the deep red fluid. He also injected melted red cacao butter into twigs of Taxus, *Fraxinus ornis*, *Rosa canina*, &c. This, when set, would block up the lumina and leave the walls unaffected. Yet he found that he could not, under these conditions, force water through the twigs. Hence he inferred that the lumina and not the walls, were the channels of water transmission.

(9) Moreover, as regards this same cinnabar experiment of Sachs, no final conclusion can be drawn from it which does not fully face all the results of the careful investigations of Russow, Bohm, Elfving, Hartig, and others into the ultimate structure of what are called "bordered pits."

It is impossible here to give detailed descriptions of these. Briefly, it may be stated that, according to these just-mentioned investigators, a most important element in the question is the regarding of the delicate membranes between the cells as being, in each case, a "klappen-ventil," or flap valve. Through this special structure the separation of the cell cavities is prevented from being so absolute as Sachs makes out. The flap valve is open to pressure from either side. Then, in Russow's own words, "When water is withdrawn from the conducting cell the air which it contains becomes rarefied, and the tension in the cell is less than in neighbouring cells. As a result, water is forced by filtration under pressure through the pits in the wall until equilibrium is restored. Then, since the air in the conducting cells is always undergoing rarefaction in consequence of transpiration, a current is set up towards the leaves from the stem." These suggestions may or may not be regarded as reliable, but they certainly go to mitigate the conclusive force of Dr. Sachs' reasons for regarding the wood cells, &c., as entirely closed cavities. Such a conception may be needful for his theory, but the real question is whether it is according to fact.

(10) Haberlandt further points out the following additional reasons for ascribing a water-conducting function to the vessels:—(1) The invariable continuity of these organs from lowest root ramification to the highest point of the leaf bespeaks a structure which would be superfluous and inexplicable if they were unused as tubes. (2) Again: there is a decided parallel between the need of an organ for water conduction, and the number and breadth of these vessels. This is especially shown in allied forms of land and water plants. Thus, *Ranunculus repens* shows three spiral vessels, with four broad fitted vessels; whilst *Ran fluitans* has but one spiral and three reticulated.

(11) It is interesting to note, as Bohm showed, how twigs of Salix, &c., in spring, if placed in water generally continue to thicken themselves; but the newly-thickened parts, even to as many as twenty rows of cells, have no vessels, there being under such circumstances no need of water conduction.

(12) Yet once more. Schwendener has most suggestively pointed out a distinct development and application of tracheides and vessels. According to his investigations the latter serve for, so to speak, the main conduits for long distances; the former branch off as side streams for shorter distances and local needs. And this certainly corresponds with the gradually increasing organisation, from Mosses upwards.

The above summary is confessedly unsatisfactory through enforced brevity. But it may serve to illustrate the opening statement that nature's most common and useful operations, which look so simple at a distance, are by no means so easily resolved on close inspection. And it may be freely acknowledged that the eminent botanists whose names have been mentioned, have grounds for holding that this particular phenomenon is not, as yet, satisfactorily cleared up. There is still room for discussion on both sides. And, as there is no lack of material, as well as ample scope for thought and ingenuity, the patient worker

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and earnest student of science may find in this direction a field of inquiry both interesting and useful. The whole subject may possibly prove to be one of those ultimate facts to the back of which it is not given to human science to get. But it is early yet to regard it in such light. And the patient, thorough perseverance of Dr. Sachs is to all of us a worthy type of the truly scientific spirit.

Our Portrait Gallery.

XII.—SIR ROBERT STAWELL BALL, LL.D., F.R.S.

THE name of SIR ROBERT S. BALL, as one of the foremost astronomers of the day, has become a household word. There are few centres of intellectual culture in the British Islands which have not, at some time or other, been instructed and enlivened by his attractive and popular discourses on modern astronomy and physics. As a lecturer, in his own special line, SIR ROBERT BALL has, probably, no living equal; and, whether delivering an address to the British Association on the Sun's Distance, or on some profound mathematical theory, or giving a popular lecture to a literary or scientific institution on the Moon and Tides, he possesses the faculty of interesting his audience, not only by giving them new facts but by the happy manner in which facts that are not new are presented to his hearers.

It is, nowadays, more than ever necessary, if we wish to induce in the masses a desire for scientific study, to render subjects that are of an abstruse nature as easy as possible to the popular comprehension. They must be made entertaining, so that the interest thus skilfully aroused may be afterwards led to rely upon more solid habits of thought. Those who have had the privilege of hearing SIR ROBERT BALL discourse upon some favourite topic will not readily forget the genial play of humour which he occasionally permits himself to introduce, and which often materially aids in fixing the memory on some important fact. The average student will more readily grasp the immensity of astronomical distances when he is told that the nearest fixed star, *Alpha Centauri*, is two hundred thousand times further off the earth than is the sun; that it would take a traveller three hundred thousand years to cover this distance by express train, and that the railway fare for the journey would reach an amount of upwards of eight hundred millions of money, third class! It is by popular illustrations such as these, added to a personal charm of manner which is no inconsiderable factor, that SIR ROBERT BALL succeeds in inducing a taste for science amongst many who would be repelled from its study by the more formal recital of scientific facts. And in his explanations of many complex problems or theories the same simplicity of style and manner is found to prevail.

But it is not only as a lecturer and author of popular scientific treatises that the subject of our present sketch has won fame. He has been awarded the Cunningham gold medal of the Royal Irish Academy for his series of memoirs in which he has developed a new branch of dynamical research, entitled "The Theory of Screws," whilst his original work in connection with the great Rosse telescope, at Parsonstown, is of acknowledged value.

The following brief particulars of his career will, doubtless, prove interesting to our readers.

ROBERT STAWELL BALL was born in 1840, at Dublin. His family originally came from Bampton, in Devonshire, and settled in Youghal, Co. Cork, about the year 1651. His father, Robert Ball, LL.D., was celebrated as a naturalist, and for many years filled the post of Director of the Natural History Museum of the Queen's University in Ireland. Educated under the well-known Dr. Brindley, at Tarvin, near Chester, and afterwards at a school at Leamington, the son showed at the first no special aptitude for serious work. He had little appreciation for those classical studies which, at that time, were considered to be the foundation of a generous education. Young Robert, however, evinced some diligence in algebra and mathematics, and especially distinguished himself (though not in a strictly scholastic sense) in chemical and pyrotechnic experiments. From 1857 to 1865 we find him enrolled as a student of Trinity College, Dublin, where he won the mathematical studentship, and was thus the first man of his year. In 1865 he became private tutor to the late Earl of Rosse, and had abundant opportunity of engaging in astronomical studies, for which he had shown a liking, with the aid of the gigantic instrument erected at Parsonstown. In 1867 he was appointed Professor of Applied Mathematics at the Dublin Royal College of Science.

Amongst the more valuable of the papers and memoirs which SIR ROBERT S. BALL has contributed for the benefit of scientific literature, may be mentioned his lectures on the Nebulæ and the Dissipation of Energy, and papers on the Method of Calculating Orbits of the Binary Stars, and Experiments on Vortex-rings. Many of his works have appeared in the *Philosophical Transactions* and in the *Transactions* of the Royal Irish Academy, and translations of some of them will be found in both the German and Italian languages. Perhaps his most celebrated treatise is that on "The Theory of Screws," which was published in complete form in 1876. Previously to that, his "Experimental Mechanics" had appeared. These works were followed by two very ably written text-books, the "Elements of Astronomy" and the "Story of the Heavens," both of which have been deservedly successful. Some of the articles in the new edition of the *Encyclopedia Britannica* (*e.g.*, those on "Gravitation" and on "Measurement") are from his pen, and he has also been a ready contributor to the magazines and periodical literature. A complete edition in German of his writings on Dynamics is now being published at Berlin.

In 1874 he was appointed to the Andrews Professorship

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SIR ROBERT STAWELL BALL, LL.D., F.R.S.

From a Photograph by Lafayette, Dublin.

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of Astronomy in the University of Dublin, to which is added the office of Astronomer Royal for Ireland. He received the honour of knighthood in 1886.

Sir Robert Ball has held many important scientific appointments, having been for many years the scientific adviser to the Commissioners of Irish Lighthouses. He has also been vice-president of the Royal Irish Academy and member of the Committee of the Royal Zoological Society of Ireland. He is a frequent attendant at the meetings of the British Association, in connection with which he gave in 1883, at Southport, one of the evening discourses on "Recent Researches of the Distance of the Sun," and at Montreal, in the following year, a lecture on "Comets." At the Midland Institute, Birmingham, he startled the world in 1881 by a remarkable discourse entitled "A Glimpse Through the Corridors of Time," in which he presented to his hearers the theory of the tidal evolution of the moon, as discovered by Mr. G. H. Darwin, and endeavoured to find in the enormously high tides of the primeval earth a new and powerful geological agent of denudation and deposition. Although the views he enunciated have scarcely been accepted by the majority of geologists, who fail to discover in the rocky strata of the earth's crust evidence of the action of such a phenomenon as a 600-feet tide—preferring to believe that the "high tide" period must have occurred, if at all, at a still earlier epoch of our planet's history—still Sir Robert Ball happily succeeded in directing more general attention to a department of astronomical geology too often neglected.

To do full justice to the many valuable contributions which he has made to science would more than exhaust our space. It must suffice if we have indicated, however imperfectly, some of the achievements which have gained for Sir Robert Ball his present position in the scientific world.

O. W. J.

A Runic Stone in the Cheshire Wirral.

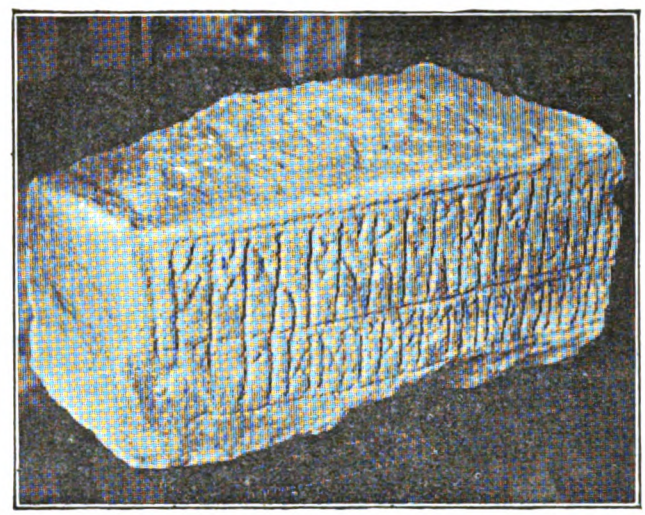
By Rev. W. Dallow.

In addition to the many curious finds that have occurred up and down the Wirral within the last few years, there has lately been brought to light an ancient stone containing a Runic inscription, which is, unfortunately, incomplete.

When the unsightly little church, which stood in the old burial ground of Upton, Birkenhead, was taken down in 1887, all stones showing any carving were purchased by a gentleman. This church formerly stood in the now disused cemetery in the grounds of G. Webster, Esq., and was the original church of Overchurch for a period of some four or five centuries It partly fell down or was blown down in 1813, and was then re-built at Upton, at the left hand side of the road to Greasby. Our oldest villager tells me it was then served monthly by a clergyman from Wallasey; it had benches for about 150, a clay floor, an old oak pulpit, a stained glass window, and one bell.

An old silver Communion cup given by Charles Bold,* Kt., of Upton Hall, to Overchurch in 1618, is still preserved at Upton Church. It bears the inscription: "Carolus Bold filius Petri Bold de Upton Armigeri dedit hunc calicem ecclesie ibidem eodemq. tempore dedit illis Bibliam 1618."

Being informed in 1887, by the man who had to take down this old church, that one of the stones taken from the wall had on it a strange inscription, I went to see it, expecting to find a Latin epitaph to some departed "worthy" of the Wirral. To my surprise the curious characters were Saxon Runes. This heavy fragment of sandstone measures about 21 inches by 10 inches, and is 9 inches thick. On the upper side is an interlaced cord pattern, similar to that on West Kirby Stones,* and a few lines are carved on the end near the corner where the Runic inscription begins. This latter is carefully cut in two rows divided by a line, and is clearly incomplete, as the stone is abruptly broken at the right side, and, judging from the *pattern carved on upper side*, would have extended to at least *four* more letters.



Overchurch Runic Stone, 1887.

The following is a Translitteration of the Runic Inscription on Overchurch Stone:—

F O L C W A R A R D O N R E C

..... W I D D O TH F O T E A TH E I E U

N.B.—"Fo'cwar" seems to be a Saxon Proper Name.

Whatever position this old stone was originally placed in is now a puzzle to antiquarians, as for centuries it was partly hidden in the church walls, with the inscription turned inwards. Thus, the letters had to be carefully cleansed from mortar, and, though the first two at the beginning of the lower row are gone, the wonder is that the others are as clear and sharply cut as they are.

After submitting the inscription for elucidation, but in vain, to various scholars, I was referred to Professor Dr. Stephens, F.S.A., London, Edinburgh, &c., now living at Copenhagen. This great scholar, who has made Runic and Norse lore his special study for 40 years, wrote in great glee stating that the stone was of inestimable value, and of 7th or 8th century. He holds that it was probably a grave-stone, or an "announcement" stone, but at present he is unable to unravel the inscription, and so the old stone yet keeps his secret from us. Further revelations just obtained on the point shall be conveyed, if allowable, to the columns of *Research*, for July.

* These curious stones, probably belonging to some ancient Saxon church or cross, were found, when certain repairs were recently made to the venerable church of St. Brigid, at West Kirby. They are kept in the "hearse-house" there. See Rimmer's "Ancient Crosses of England," pp. 95, 96, 97, for illustrations of them.

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Museum Notes.

THE circulation of travelling-boxes of selected specimens of natural history from the Liverpool Museum amongst the various Board Schools in the city has had an encouraging effect since its introduction in 1884. The Rev. H. H. Higgins recently reported to the committee of that institution that these boxes had been the means of inducing large numbers of school children to visit the Museum, so that on the occasion of school holidays the attendance was often very large.

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AT a meeting of the trustees of the Derby Museum at Liverpool, the report of the keeper (Mr. T. J. Moore, Cor. Mem. Z.S.) was read and approved. The report stated that in the past half year the visitors numbered 107,978, against 108,752 in the corresponding period of the previous year. The renewed experiment of opening the Museum on Monday evenings from 7 to 10 commenced in October, and was continued to the end of March, and then closed for the winter. The visitors were of all classes and ages, working men predominating. Their demeanour was all that could be desired, and no instance occurred of the levity and boisterousness which led to the discontinuance of the first experiments in Monday evening openings, which were commenced in October, 1863, and were terminated in March, 1871. A popular address was delivered on each evening in the immediate neighbourhood of objects likely to sustain the interest of such audiences as could congregate around, *e.g.*, on the cattle and sheep, on the skeleton of the hand and foot in man and animals, &c. They rarely exceeded half an hour in duration, and invariably gave pleasure and satisfaction. Professor Herdman undertook one of the addresses, that on Zoophytes and Jelly fishes; the others were delivered by members of the museum staff or volunteers from the scientific institutions of the city on biological, mineralogical, geological, or historical subjects, and from other departments of the Museum generally. The Derby specimens (to which alone this report refers), both stuffed and in skin, continue in good preservation.

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ONE of the greatest attractions in Malton, Yorkshire, is the Museum of the Field Naturalists' Society, which contains an admirably-arranged collection illustrating the geology of the Lias and the Chalk, and including many rare species. The largest cretaceous ammonite known (*A. leptophyllus*), from Thixendale, is contained in the Museum. This colossal specimen is 4 feet in diameter, and the breadth of the outer whorl is 21 inches. Besides these, the local botany, conchology, zoology, and archæology are all well represented in the Museum.

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THE Grosvenor Museum, Chester, has been presented with a series of specimens, numbering about thirty, of relics and antiquities from the Meols shore, near Hoylake, the site of the discovery of the celebrated archæological relics mentioned in Canon Hume's *Ancient Meols*. The donor is Mr. J. Romily Allen, F.S.A., of London.

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A VALUABLE collection of European plants was made by the late Rev. J. H. Thomson, Vicar of Cradley, whose death is announced. It is understood that the collection is bequeathed to the Museum of the Worcestershire Naturalists' Field Club.

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SOME additions of more than ordinary interest have been made in the zoological department of the Leicester Town Museum, amongst the most striking being a preliminary instalment of fish models made in a new material. Good plaster casts of fishes have been made by the late Frank Buckland and others, but the material has many undesirable qualities. When cast, plaster is extremely heavy, and is difficult to colour, except by an expert, and even then has neither the texture nor the "fishy" appearance of the actual subject. Not even the skill of that well-known piscatorial artist, the late Mr. Ralfe, who, we believe, coloured many of Frank Buckland's models, nor the efforts of lesser luminaries, quite succeeded in giving that air of realism so much desired. A medium which should combine the sharpness of plaster and the pliability of wax with practical indestructibility and extreme lightness was always a desideratum.

MR. MONTAGUE BROWNE, F.Z.S., Curator of the Leicester Museum, has brought to perfection a new process of preparing models of fishes, and some marvellous results are now open to inspection. A skate, originally weighing 2 cwt., finished in the new material, weighs only a few ounces. An "angel fish," originally 50 lbs., is now a little over 3 lbs., and exhibits not only the exact contour of the fish, but the lateral lines and minute granulations of the skin in such a manner as not only to be readily perceptible to the eye, but to be rough to the touch "when stroked the wrong way."

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PERHAPS the gem of Mr. M. Browne's handiwork is a common plaice (*Pleuronectes platessa, Linn.*), which has the appearance of the actual fish preserved in some subtle manner. All the minute tubercular elevations of the skin are reproduced with a sharpness of detail which leaves nothing to be desired. In addition to this, the whole treatment of the subject is skilful and artistic, and the effect is heightened by the reproduction of the lovely tints and delicate gradations of colour seen in the living specimen. The new process may safely be left to stand upon its own merits.

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LIVERPOOL MUSEUM.—The Aquarium at this institution has been enriched by the receipt of two living specimens of *Lepidosteus*, or bony gar-pike, sent by Mr. Eugene Blackford, U.S. Fish Commission, New York, in exchange for five soles. The fish are young, measuring about 14 inches in length, and are highly valued as being the first of their kind brought to the Museum, and probably to Europe, if not forestalled by specimens from the same source shipped by the German Lloyd's steamer for the Brighton Aquarium. The *Lepidostei* are armour-plated fishes, found only in the river system of North America, numbering some half-dozen species, and represent the ganoid fishes of the early geological formations.

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MR. T. J. MOORE, Cor. Mem. Z.S., communicated to the last meeting of the Liverpool Literary and Philosophical Society the following interesting note on a rare specimen of *Ovis polii* recently acquired by the Liverpool Museum:—

Marco Polo, in his celebrated book of travels through Central Asia in the 15th Century, was the first to make known the existence of large races of wild sheep in the elevated plains of Tamir, eastward of Bokhara, 16,000 feet above the sea level. These are known to consist of several closely allied species, the first of which was named in 1840 by Blyth, in honour of the celebrated traveller, from the only skull and horns then known in Europe. In very recent years, other species have been named and described by explorers, but all are surpassed in size by the *Ovis polii*.

In the *Field* of Sept. 8th, 1888, appeared the following brief note from a correspondent signing himself simply under the letter "A":—

"OVIS POLII SHOOTING IN THE TAMIR.

"I have received a letter from Mr. St. George Littledale, dated Lake Kara Kol, the Tamir, Aug. 2nd, who, with his wife, has succeeded in penetrating to those districts, and shooting several fine specimens of the *Ovis polii*, at an elevation of some 13,000 feet. The only museum known to have a complete specimen is that at St. Petersburgh."

In December, a fine skull of an adult male was purchased for the museum from Messrs. Rowland Ward & Co, London, measuring 41½ from tip to tip of horns. On the 12th March last I received the following brief letter from Mr. St. George Littledale, dated Wick Hill House, Bracknell (Berkshire):—"I hope, in the course of a day or two, to send you a skin and skull of the *Ovis polii*, which I got last autumn on the Tamir. We are off again in a couple of weeks to Chinese Mongolia, in quest of the true *Ovis ammon*, not the Ladak sheep of the name."

In a few days two skins, male and female, were received, followed by the skull of a fine adult male.

Suffice it now to say remains of *Ovis polii* have been almost unknown in European or other museums, and that the time, energy, and expense involved in their capture daunt the most enthusiastic sportsman.

The following are measurements of skulls of our two specimens of *Ovis polii*:—

		Mr. Littledale's.	Purchased.
Tip to tip		43½	41½
Greatest curve	*r.*	54½	56
	l.	55½	58½
Circumference at base	*r.*	15½	15½
	l.	15½	15½

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THE second annual report of the Curator to the Bootle Free Library and Museum for the year ending March 28th, 1889, drawn up by Mr. J. J. Ogle, states that during the year the entire collection of birds, including some hundreds in the store-room, has been overhauled and properly classified. In the departments of geology, mineralogy, and physiology the

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collections have been further improved by re-arrangements and additions. Addresses explanatory of the contents of the Museum have been given during the winter months. A small fresh-water aquarium and vivarium have also been exhibited. In the art rooms, cases of Indian metal work, Persian pottery, textiles, plated ware, and drawings and photographs of art designs were lent by the South Kensington Museum, and several pictures on loan have been exhibited. Twelve free lectures were also given during the season in the lecture hall.

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MR. HOWARTH, curator of the Sheffield Museum, has brought before the Museum Committee of the Town Council a proposal for the loan of cabinets of specimens to schools. Accompanying the cabinets would be suitable descriptions enabling the teachers to give intelligent object lessons. This plan has already been adopted with success in Liverpool and Birmingham.

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A MEETING of museum curators was held at York, on May 3rd, on the invitation of the council of the Yorkshire Philosophical Society. Another meeting is called to meet at York, on June 20th, when representatives of all provincial museums are invited to attend to consider the formation and constitution of a proposed Museums Association.

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UNIVERSITY COLLEGE, LIVERPOOL.—Mr. T. Salter, of the s.s. "Marranense," has brought home a fine young male specimen of the Manatee (*Manatus Americanus*), and has presented it to Prof. Herdman for the Zoological Museum at University College. The specimen has now been dissected; the heart, stomach, and some of the other more interesting organs are being kept as museum specimens. The skin will be stuffed, and the skeleton will be prepared and mounted.

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Field Geologists in Yorkshire.

THE field geologists of Yorkshire have given fresh evidence of their activity in commencing the season with some excellent practical excursions. The Easter excursion of the Leeds Geological Association was held in the vicinity of Brough-on-the-Humber, where the Post-Tertiary gravels and Oolites were examined. Mr. B. Holgate, F.G.S., led the party, which was also joined by some members of the Hull Geological Society, under Dr. F. F. Walton, F.G.S., their president. We extract the following notes of excursions from accounts kindly furnished us by Mr. S. A. Adamson, F.G.S. :—

At Brough, on the top of the low prominence of Mill Hill, a gravel pit has been excavated. The hill is an Oolitic outlier capped by Post-Tertiary gravels. Mr. Lamplugh gives the following section of this pit :—Top soil, &c., 2½ feet; rough, stony gravel, with some sand, and containing pebbles of flint, sandstone, red chalk, oolitic limestone, and other local rocks, also a few well-worn erratic pebbles of felstone, quartzite, &c., also rolled lumps of clay and thin seams of clay and of carbonaceous matter, about nine feet; yellow sand with stony layers, the stones included similar to those in gravel above, about five feet; then succeeds some hard, grey, or whitish clays, probably belonging to estuarine oolites, but thickness uncertain. In the yellow sand a mammoth's tusk was found. This pit showed splendid examples of cross bedding. The varying currents must have been swift—in fact, almost torrential. Here and there in the upper gravels "pipes," or roughly-shaped pillars, descending from the top soil, are to be seen; these have probably been caused by the decomposition of tree roots and stems, the cavities being filled up by earthy and calcareous matter, which have since, by percolation of water, become very compact and hard—so much so, that we were told they could be left standing as pillars whilst quarrying or digging was going on.

Leaving the hill, and returning to the Ellerker Road, we entered a small hollow, where there was an exposure of oolitic limestone, described by Dr. Walton as "flaggy, thin, soft, yellow, and irregularly bedded with numerous fossils." Among others have been found *Terebratulæ*, *Trigoniæ*, *Rhynchonellæ*, *Pinna*, *Modiola*, &c. On the west of the road, a little further on, we entered the large Brough Gravel Pit. This had many points in common with the one we had visited at Mill Hill; the "pipes," however, were much more conspicuous and numerous. A large block of quartzite, about three feet in diameter, with outer surface slightly smoothed, was noted. In one part of the quarry, about three feet below the surface, the workmen had disinterred some human bones, accompanied by fragments of rude pottery, these probably, from the roughness of their make, being British. Some of the bones were examined, and, as far as a hurried inspection could decide, were said to be portions of the pelvis and femur of a female. Recently a skull, with teeth in perfect preservation, was found in this quarry.

Further on the "Cockle Shell" Quarry was visited, and the following section seen :—Rubbly oolite, 6 feet; compact limestone, 2 feet 6 inches; thin, brown rubbly oolite, 2 feet; compact limestone, 3 feet; rubbly limestone, 10 feet.

An excursion of the Leeds Association was subsequently held at South Milford and Sherburn, for the study of the Magnesian Limestone and Marls. At Milford the Upper Limestone is exposed; at the top it is thinly bedded and rubbly, then the stone is of a more compact character, being thickly bedded and massive; below the last-named beds the stone is again in thin layers. The thick limestone is of a greyish colour, very hard, and in some places crystalline. In one part of the quarry under the grey limestone, and about seven feet below the floor of the quarry, the beds are of a reddish hue and highly fossiliferous. The activity of the members was well rewarded, and all had a trophy to exhibit in some weathered fragment, displaying on its surface, like a rich arabesque, the fossil remains of molluscs and algæ. The thick limestone is quarried for road metal. The party then proceeded to Sherburn, Bishop's Dyke, and a fine exposure of the Upper Limestone at Stream Field Farm Quarry, where occur well-defined, dome-like bends in the rock, the result of lateral pressure. Geology and archæology can often be well studied together, and at Sherburn the members found full opportunity of indulging in their tastes for the latter science in addition to the former.

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Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between April 16th and May 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	Highest (April 19th)	30·17	Inches.
,, ,,	Lowest (April 24th)	29·34	,,
,, ,,	Mean	29·815	,,
,, ,,	,, for 22 years April	29·886	,,
,, ,,	,, ,, May	29·965	,,
Temperature	Highest (May 5th)	71·0	Deg. F.
,,	Lowest (April 25th)	36·0	,,
,,	Mean	50·9	,,
,,	,, for 22 years April	47·2	,,
,,	,, ,, May	51·6	,,
,,	,, of Evaporation	47·0	,,
,,	,, ,, for 22 years April	43·5	,,
,,	,, ,, ,, ,, May	47·7	,,
(*b*) Rainfall	Amount	2·571	Inches.
,, ,,	,, Mean for 22 years April	1·587	,,
,, ,,	,, ,, ,, May	1·892	,,
,,	Number of Days on which Rain fell	20	
,,	Greatest fall in 24 Hours (May 11th)	0·590	Inches.
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·4	
,,	,, ,, for 22 years April	6·4	
,,	,, ,, ,, May	6·2	
(*c*) Wind	Velocity, Greatest (April 20th)	42	Miles.
,,	,, Least (April 18th)	1	,,
,,	,, Mean Hourly	14·8	,,
,,	Greatest Pressure on Square Foot (April 20, 9·0 p.m.)	22·8	Pounds.
,,	Direction at time of Greatest Pressure	SW	

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Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
35	75	168	103	93	142	80	24	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

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Bolton.

During the week ending April 21st barometric pressure was about the average, with slight range; corrected mean temperature up to the average value for the week; weather bright, with gentle showers during the last three days. Averages:—Barometer 29·969 in.; temperature 44·27°; humidity 82%; total rainfall on three days 0·329 in.; sunshine on six days 17 hours 44 minutes; prevailing wind W. The remainder of the month was of the true April type—sunshine and shower; pressure very unsettled, but only moderate range; temperature above the average. Averages:—Barometer 29·751 in.; temperature 44 77°; humidity 74%; total of rainfall on eight days 0·898 in.; sunshine on nine days 36 hours 26 minutes; wind variable.

The means or totals for the month of April were:—Barometer 29·761 in., with 16 oscillations; corrected mean temperature 42·50, nearly 2° below the average; the temperature of the soil at one and two feet deep averaged 3°, and water at one foot deep 5°, more than last April; no frost registered in the shade, but the minimum on the grass (owing to terrestrial radiation) showed more or less frost on 11 nights; humidity 79·8%; rainfall on 21 days 2·703 in.; bright sunshine recorded on 23 days 64¾ hours; prevailing winds Easterly. A slight thunderstorm occurred on the 22nd at 1 p.m.

With the opening of the month of May a remarkable change in the weather took place, warm, bright, summer-like in character. The sudden rise of temperature produced electrical disturbances in the atmosphere, and thunderstorms occurred on the 1st, 4th, 5th, and 7th. The barometer was steady, mean temperature about 6° above the average. Averages:—Barometer 29·810 in.; temperature 53·44° (59·85° on the 5th); humidity 73%; total rainfall on four days 0·921 in.; sunshine every day, total 32 hours 4 minutes; prevailing wind Easterly. From the 8th to the 14th mild, genial weather continued, but the humidity prevented much bright sunshine. The rapid growth of grass and the sudden bursting into foliage of shrubs and forest trees was phenomenal. Averages:—Barometer 29·801 in.; temperature 50·51°; humidity 87%; total rainfall 1·320 in. during five days; sunshine on three days 7 hours 23 minutes; winds N.E.

In my last report I thought the conclusion might be drawn from the figures of accumulations of "growing temperature," rainfall, and sunshine that there was much promise in the agricultural outlook. The following table of accumulations for the period of the year ending May 14th gives a more emphatic proof of promising crops:—

Accumulations of	1887.	1888.	1889.	Marlborough. (20 years' av.)
Growing temperature	629·7°	505·1°	720·0°	574·2°
Rainfall	7·31 in.	9·733 in.	12·087 in.	11·620 in.
Bright sunshine	342h. 41m.	248h. 24m.	242h. 24m.	No records.

With 25% of accumulated growth above the average, and the full average of rain and sunshine, agriculturalists and floriculturalists may take heart again and fairly anticipate a bountiful harvest.

W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, May 17, 1889.

Sheffield.

METEOROLOGICAL SUMMARY.

April, 1889.	TEMPERATURE. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for April, Daily Max.*	Daily Min.*	RAINFALL. Total Ins.	No of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Apr.* Ins.
Sheffield ...	62°	18th	34°	3rd	44°	—	—	3·64	19	0·42	5th	—
Spurn Head.	56°	20th	30°	4th	44°	—	—	1·40	20	0·24	7th	—
York	64°	18th	30°	15th	45°	54°	38°	1·56	18	0·23	7th	1·86
Barrow	55°	25th	37°	11th	45°	—	—	1·82	16	0·49	3rd	—
Liverpool ...	57°	27th	33°	11th	45°	53°	41°	3·05	24	0·33	10th	1·56
Holyhead ...	55°	18th	36°	9th	45°	52°	42°	2·31	18	0·41	9th	1·86
Oxford	64°	18th	32°	26th	45°	55°	39°	2·89	22	0·58	9th	1·79
London	65°	19th	35°	26th	47°	57°	40°	2·34	20	0·44	24th	1·86

* The means of Temperature and Rainfall for April are for 15 years.

April 16 to May 15, 1889.

PRESSURE.

On April 16th pressure was high and even, being 30·0 in. all over Britain, and it gave way very little on the 17th and recovered slightly on the 18th, but fell in the N.W. to 29·8 in., and rose to 30·2 in. in the S.E. on the 19th. It fell further on the 20th, the isobars being close and running from W. to E., and varying from 29·6 in the N. to 30·1 in the S. Pressure increased on the 22nd but was still low, and it gave way again on the 23rd, and on the 24th a depression whose centre almost covered England had travelled from the W., and the barometer reading was down to 29·4 in. The depression had passed to the E. of our coasts on the 25th, and the barometer was rising briskly; but a fresh disturbance from the W. caused a further fall of the barometer on the 26th, which, however, recovered again on the 27th, but fell once more on the 28th, when the readings ranged from 29·6 to 29·8 in. The barometer was falling in the S.W. on the 29th, but rising slowly in the N., and on the 30th there was a general fall, pressure being down to 29·4 in. in the S.W. and 29·9 in. in the N.E. From May 1st to the 10th a series of shallow depressions followed each other across the country, and pressure was rather low all the time and did not vary very much, the barometer readings ranging from 29·4 in. to 29·8 in. On May 11th pressure had risen to 29·9 in. in most places, and remained much the same on the 12th, 13th, 14th, and 15th.

THE WEATHER.

From April 16th to the 22nd the weather, during the first part of the time, was warm and genial with bright sunshine, temperature on the 18th and 19th rising above 60° in many parts of England. On the 20th, however, the weather again became cloudy and showery, and continued so on the 21st, becoming fine again on the 22nd. There was rain on four days at Liverpool, three at Holyhead, two at Sheffield, Barrow, London, and Oxford, and one at Spurn and York. The following week, from April 23rd to 29th, the weather again became showery, and there were heavy falls of rain, with occasional bright intervals of sunshine, and several thunderstorms occurred. Temperature varied considerably, and on the 25th and 26th frost was experienced in many parts of England, but at the close of the week temperature had again risen to 60°. There was rain on seven days at Spurn and London, six at Liverpool, five at Sheffield, Holyhead, and Oxford, and four at York and Barrow. During the week ending May 6th the weather was changeable and unsettled, and there were frequent thunderstorms and heavy showers, but at times the weather was bright and genial. Temperature was low at the beginning of the week but rose during the latter part, exceeding 70° at Oxford, Cambridge, London, and other places on the 4th, 5th, and 6th. There was rain on six days at Barrow and Holyhead, five at Liverpool, four at Oxford, three at York and London, and two at Sheffield and Spurn. From May 7th to 13th the weather underwent considerable change. For the first half of the week it was fine and

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bright in most parts of the kingdom except the W., where it was dull and misty. Temperature was high and the air soft and pleasant. There were some severe thunderstorms and heavy showers, but they were very local in incidence. The last half of the week the weather improved in W. but became dull and showery in the E., and temperature fell generally. There was rain on six days in Sheffield, Liverpool, Holyhead, and Oxford, five at Barrow, four at York and London, and three at Spurn. The following two days (May 14th and 15th) the weather was fine on the whole, though cloudy and foggy in places, but there was very little rain anywhere. No rain fell at any of the places mentioned above.

SUN SPOTS.

From April 16th to May 4th the sun was examined on twelve days, and was quite free from spots. On May 6th a moderate-sized spot was visible about 3° from the eastern limb, with well-defined nucleus and penumbra, and surrounded by large faculæ, which extended to the edge of the disc. The spot was above the equator, and had evidently come into view by rotation of the disc. The spot was visible on the 7th and 9th further on the disc, and rather smaller on the latter date. The sun was invisible in Sheffield from the 9th until the 15th, and it was then spotless.

E. HOWARTH, F.R.A.S.

Museum and Observatory, Sheffield, May 20, 1889.

Societies.

THE ROYAL SOCIETY.—The annual soirée of the Royal Society was held on 8th May, and the gathering was fully as brilliant as any of its predecessors. Amongst the 500 guests welcomed by Professor Stokes, the president, were many of the most eminent workers in the field of science. We have not space to enumerate all of the very interesting exhibits displayed in the rooms of Burlington House on this occasion. The following, however, attracted the most attention from the critical assemblage who were present:—The Tainter graphophone was shown by Mr. J. W. Howard. A new instrument for measuring colour-blindness and differences of colour vision was shown by Mr. W. J. Lovibond. Mr. C. V. Boys produced his apparatus for demonstrating the attraction of gravitation and experiments in the insulation of quartz. In the domain of photography were Mr. Isaac Roberts' celebrated photographs of the great nebulæ; Mr. Wm. Crooke's photographic exposition of the normal solar spectrum made by Prof. Rowland, of John Hopkins University, U.S.A.; and Mr. R Muybridge's demonstration of the phases of bipedal locomotion by means of automatic electric photographs. Amongst the botanical varieties was a novel specimen of a gigantic 'cuckoo pint" (*Amorphophallus Campanulatus*), from tropical Asia. Ancient plant remains from an Egyptian cemetery were shown by Mr. Newbury. These remains date from the first century B.C., and were discovered by Mr. Flinders Petrie. Several physical experiments were shown by Mr. Eric S. Bruce, Mr. Shelford Bidwell, Mr. Pitkin, Prof. Lockyer, and others. The models this year were exceptionally interesting. Dr. C. Ricketts, F.G.S., showed his models illustrating the effects of pressure on layers of sand, clay, &c. (originally shown at the last meeting of the British Association). The *piece de resistance* of the evening, however, was an interesting working model of ocean currents, shown by its inventor, Mr. A. W. Clayden. This comprised a large tank of water, in which stood a relief model of the world on Mercator's projection. By means of an ingenious arrangement of air-pipes and bellows streams of air were sent through certain tubes, forming miniature ocean currents which, including the Gulf Stream, were shown in motion. Mr. Clayden showed how, by wiping out a large tract of Central America, the current of the Gulf Stream could be diverted, and the climate of Britain changed to one of greater severity. The narrow Panama Canal would not, however, cause any difference in this respect.

ST. MARGARET'S NATURAL HISTORY SOCIETY, WESTMINSTER.—The monthly meeting was held on Friday, May 3rd, in the Boys' School, St. Margaret's, Westminster, E. H. Fedarb, Esq., in the chair. After the minutes of the last meeting had been read and passed, a letter from Mr. Martin Cheek was read by the chairman, giving an account of the gold mines at Dolgelly, N. Wales. After this an account of the life of Edwards, the naturalist, was read by Mr. Row. The following specimens, &c., were shown:—1. Auriferous quartz and other minerals from Wales; 2. Shark's teeth and other fossils; 3. Collection of photographs. The attention of members was called to the cheap editions now published of Darwin's *Voyage of a Naturalist.*

ZOOLOGICAL SOCIETY OF LONDON.—The 60th anniversary meeting of this society was held on 28th April, Professor W. H. Flower being in the chair. The report of the council for 1888 was read and adopted. It stated that the total receipts for the year amounted to £24,025, showing an increase of £922. In the gardens in the Regent's Park the work during the past year had been confined to repairs and renewals. The total number of visitors to the gardens had been 608,402. The number of animals in the society's collection on December 31st was 2,290, of which 666 were mammals. 1280 birds, and 344 reptiles.

CLYDESDALE NATURALISTS' SOCIETY.—The ninth and concluding meeting of the eighth session was held on Wednesday evening, May 15th, in the society's rooms, 207, Bath Street, Glasgow, Mr. T. J. Henderson in the chair. Mr. J. Macnaught Campbell, F.R.S.G.S., exhibited a number of specimens of great interest, including reversed examples of the common flounder, *Pleuronectes flexus*, from Clyde; two fine skulls of the tapir, male and female, from British Guiana; and specimens of the coco-de-mer or double cocoanut, *Lodoicea seychellanum*, from the Seychelles Islands. This remarkable fruit has a curious traditional history, and, until recent times, only being known as cast up by the sea, was supposed by old writers to be produced beneath the waves. The late General Gordon, who brought together a large series of specimens, now at Kew, believed that he had good grounds for identifying the coco-de-mer with the forbidden fruit of the Garden of Paradise. Mr. George Ord showed specimens of toothwort, *Lathraea squamaria*, found growing on hawthorn roots near Cambuslang on 20th April last. This is one of the rarer plants of the Clydesdale flora, and has not been recorded as found in the district for many years. It belongs to the curious natural order orobanche, the whole of the species of which are parasitic on other plants. Mr. James S. Dixon exhibited eggs of the kingfisher, one taken this month on the Clyde, near Bothwell, and another about nine years ago on the Avon, near Hamilton. The former was found on 6th May last in a nest at the end of a hole bored about 2ft. 3in. straight into the river bank, about 6ft. above the water and 18in. under the top of the bank. The passage was oval in form, about 2in. by 1½in., and ended in a circular cavity 5in. in diameter. The nest had no lining, only a few fish scales being scattered about, while at the mouth there were many droppings. Although the nest contained only one newly-laid egg the female bird sat as closely as if she had been hatching. Mr. John Young, F.G.S., exhibited a vertebral column of the haddock, *Gadus aegilfinus*, showing a remarkable abnormal thickening of 17 of the spinal bones, by which they had been welded into a solid mass. This occurrence is known to steologists as Hyperostasis. Mr. George G. Mackenzie brought forward a contorted specimen of an ammonite, *Ammonites carinatus*, from the phosphate beds of Sussex, one portion of the whorl being at right angles to the remainder. Mr. D. C. Glen, F.G.S., exhibited a fine example of specular iron ore from the Island of Elba, a cargo of 1200 tons having been recently imported to the Clyde for industrial purposes. Mr. James B. Murdoch, F.R.Ph.S.E., read some interesting notes upon the occurrence and collection of the semi-fossil Kauri gum, a product of the Kauri pine, *Dammara*

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australis, an evergreen tree peculiar to the North Island of New Zealand. The major portion of this gum now found is got several feet below the surface of the soil, where it is probed for and dug up by "gum-diggers," a class of men who devote themselves to this work. It has been deposited after the decay of trees which flourished and died ages ago, and is analogous in its occurrence to amber, ambrite, succinite, &c. At present Kauri gum forms an important article of export from the colony, no less than £350,000 worth having been shipped from the province of Auckland in 1887. It goes to London and America, being principally used in the manufacture of varnishes and lacquers. The timber of the recent trees is also being largely exported, and a recent authority—the Conservator of State Forests of New Zealand—says that at the present rate of destruction the forests of Kauri pine will be entirely exhausted within the next 26 years. By the kindness of Mr. Young and Mr. Glen, the paper was illustrated by a number of specimens of Kauri gum and allied substances. After a hearty vote of thanks to the contributors for the evening the Chairman declared the session to be closed, and hoped that the members would be enabled to meet in health and strength at the commencement of the new one, next September.

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Liverpool Naturalists' Field Club.—On 4th May this society had their first out-door meeting for the present season, and visited Ellesmere Port, Pool Hall, Hooton Woods, and Little Sutton. About sixty members and friends started from Birkenhead for Ellesmere Port, a place which is mainly remarkable for its growth since the commencement of the works of the Manchester Ship Canal. In the early part of the present century it is stated that it only contained a few small cottages. The party followed the footway to Pool Hall, an interesting old building, at present used as a farm-house, and with an outward appearance suggestive of neglect and decay. It is supposed to have been built in the reign of Henry VIII. Crossing the open fields, some members, under the guidance of Mr. G. H. Morton, F.G.S., inspected the works of the Manchester Ship Canal, which are here making considerable progress; but the majority explored the banks of the little brook which meanders in a miniature valley, having the slopes well clothed with primroses and other vegetation. By kind permission of Colonel Mousley, the Hooton Hall Woods were entered. The reward was a most enjoyable ramble by beds of wild hyacinths and under the boughs of huge beech trees, the latter some of the finest specimens near Liverpool. Crossing the road, the route was next through the park to the lodge by the church, and so to Little Sutton. Afterwards a number of new members were proposed and duly elected. The prizes were awarded as follows:—The orders for the day, *Ranunculaceæ* and *Cruciferæ*, to the Rev. S. Gasking, with eleven species; and for the best-arranged basket of wild flowers to Miss H. J. Hunter. The botanical enigma, *Potentilla Fragriastrum*, was found and solved by Miss Power, Miss E. Jee, Miss Moss, Miss H. J. Hunter, Miss E. M. Wood, Rev. S. Gasking, Mr. David Price, and Mr. R. Drummond Brown.—On 9th May this society commenced the series of fortnightly evening outdoor meetings for the present year, by a visit to Kirkby. This is a pleasant bit of country, intensely rural for the distance from Liverpool, and abounding in plants of considerable botanical interest. The extensive moss ground that formerly existed in this neighbourhood is now almost entirely drained, and cultivated fields extend over the large area that was formerly waste. An addition was made to our knowledge of the flora of this particular route in the discovery of several patches of *ranunculus auricomus* (the goldilocks), a member of the same family as the more familiar buttercup, and decidedly rare in the Lancashire portion of the Liverpool district.

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Liverpool Biological Society.—The last indoor meeting of this society for the present session was held in University College, on Friday, May 10th, 1889. There was a very good attendance of members and a large programme. Prof. Barron showed an insect larva removed from an abcess in man. These are common as parasites in man in British Honduras, from whence the man came. Dr. Ellis recognised the larva as one of a dipterous insect, allied to œstrus. Mr. G. F. Moore read a note on M. Carlier's theory of the limb-nature of the vertebrate jaws, and he and other members pointed out the extreme weakness of M. Carlier's arguments. Mr. Thompson carefully described and showed drawings of quite a new kind of copepod, which had been dredged up by Mr. W. S. Macmillan's new deep tow net. It was obtained from mud from the bottom of Port Erin Bay during the last "Hyæna" cruise. It is a very small copepod (⅛ inch), with beautiful plumose antennæ. Prof. Herdman and Mr. Clubb read some "Notes on Nudibranchiata." These consisted of a record of the species which have been found since the last report, along with some anatomical and histological observations upon certain species. The authors find that in *Dendronotus* the liver does not, as is commonly supposed, give off prolongations into the dorsal papillæ, but that these papillæ contain only blood sinuses, which have nothing to do with the liver. They also gave some notes upon the stinging cells of *Eolis*. Prof. Herdman read his second report of the tunicata of the L. M. B. C. district. He described three species new to the district, and one new to science. He paid particular attention to the copepods parasitic on the tunicata, and showed that they were only found on those forms possessed of few and simple tentacles. He also described two species which had grown to a very large size in the large plunge bath of the Llandudno Hydropathic. Up to the present 51 tunicates are known in the district, and of these 18 have been found at Puffin Island. Mr. J. J. Moore read a report on the seals and cetaceans of the L.M.B.C. district, including five varieties of whale and two seals. His paper was well illustrated by preparations and drawings. Mr. W. B. Halhead placed on the table his report on the Pycnogonida of the district.

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Puffin Island Biological Station.—In addition to other work at this station, Professor Herdman has been engaged for some days during the past month in continuing his observations on the "zones" of the shore, begun some time ago. He is also continuing his experiments on the power of different marine animals to withstand periodic exposure to air and fresh water.

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The Warwickshire Naturalists' and Archæologists' Field Club.—The above club held their annual meeting as usual at the Museum, Warwick, on Tuesday, March 26th, 1889. The president, the Rev. P. B. Brodie, M.A., F.G.S., delivered a short address, in which he traced the progress and work of the club from its origin in 1854. He regretted that most of the original members had been removed by death, though he congratulated the club on the active zeal of many of their successors, and he trusted they would always maintain the credit of the society, and especially in the "Proceedings" annually issued to all scientific societies and field clubs both in London and the provinces. He mentioned the loss the club had sustained in the death of their late president, M. H. Bloxam Esq., at an advanced age, and whose place as an eminent archæologist it would not be so easy to fill up. The club was strongest in archæologists. Geologists were few, and botanists and entomologists still fewer, and zoologists only one, who rarely attended. In conclusion he expressed a hope that these deficiencies would be made up for the future. The following papers were read:—(1) "On Some Bore-holes Recently Made at Coventry," by W. Andrews, Esq. (2) "A Quarter of a Century's Retrospect of the Warwickshire Field Club," by W. G. Fretton, Esq., F.S.A. (3) "On the Character, Variety, and Distribution of the Fossil Insects in the Palæzoic (Primary), Mesozoic (Secondary), and Cainozoic (Testiary) Periods," by the Rev. P. B. Brodie, M.A., F.G.S.

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GEOLOGICAL SOCIETY OF LONDON.—On April 17th the following papers were read: (1.) "On the Production of Secondary Minerals at Shear-zones in the Crystalline Rocks of the Malvern Hills," by Dr. C. Callaway, F.G.S. The author had previously shown that many of the schists of the Malverns were of igneous origin. Thus, mica-gneiss had been formed from granite, hornblende-gneiss from diorite, mica-schist from felsite, &c. The changes which the respective minerals of the massive rocks had undergone were now discussed. The evidence collected seemed to prove that the schist-making had taken place subsequently to consolidation; but it was clear, especially where the rock was heavily sheared, that the constituents had been re-dissolved and re-constructed. The secondary origin of the micas and part of the felspar was proved by the fact that they were moulded on decomposition products, such as chlorite or epidote, and upon fragments of hornblende crystals, which had been crushed during the shearing. The mineral changes described resulted from constant action *plus* mechanical force. (2.) "The Northern Slopes of Cader Idris," by Grenville A. J. Cole, F.G.S., and A. V. Jennings, F.L.S. The present paper dealt with the nature of the eruptions that took place in this area, and the characters of their products at successive stratigraphical horizons. The most striking mass upon the mountain is the main "felstone" (eurite) of the wall, which proves to be minutely "granophyric," and of very uniform grain throughout. An analysis, by Mr. T. H. Holland, shows seventy-three per cent. of silica. This vast intrusive sheet is regarded as, perhaps, of no later date than the Llandeilo lavas of Crag y-Llam, and as a forerunner of the volcanic conditions that prevailed in Bala times throughout North Wales.

GEOLOGICAL SOCIETY OF GLASGOW.—The eighth meeting of the 31st session was held on Thursday evening, 9th May, in the Society's rooms, 207, Bath Street, Mr. D. McMillan, vice-president, in the chair. Mr. William Douglas was elected an ordinary member. Mr. Dugald Bell, vice-president, read a paper entitled "Phenomena of the Glacial Epoch, II.—the 'Great Submergence,'" being in continuation of one he read last year on the distribution of boulders. On this occasion Mr. Bell referred particularly to the alleged "Great Submergence" of the land to a depth of 1,500 or 2,000 feet beneath its present level during part of the glacial epoch. He felt constrained to express his disbelief in such a submergence, though it had been asserted by many eminent writers. He pointed out the imperfect nature of the evidence adduced in support of it; the absence of such evidence over the country generally; and the fact that in various instances particulars had been brought forward as proofs which were not really so. Judging from marine shells, there is no evidence in Scotland of a greater submergence than a little over 500 feet, and even a question arose whether it could be so much. But, accepting this in the meantime, it corresponded very nearly with what had been made out in regard to other countries in the northern hemisphere, as Norway on the one hand and North America on the other. Probably, therefore, this was about the limit of the submergence, which might have been due, as suggested by Dr. Croll and others, not so much to an actual depression of the land as to an attraction of the waters of the sea towards the pole where the ice was in force. With regard to the few instances in England and Wales and in Ireland, where shells have been found in "drift" at higher levels —from 1,200 to 1,400 feet—the author pointed out that in every case these bore marks of not being really in place, or as left by the sea. The underlying rocks were striated; the sands and gravels were irregularly bedded, and contained far-travelled stones, with some which had been brought from a lower level; the shells themselves were mostly fragmentary, and consisted of shallow and deep water species confusedly mixed together. In short, these instances, from which the deep submergence was mainly inferred, presented every appearance of glacial origin, of having been deposited by the great mass of ice which filled the Irish Channel from side to side, pressing up over the land at these points. Mr Bell instanced similar results which are known to have been produced by the ice in other localities, not only boulders but shells having been carried up to considerable heights, and showed that this was probable from the configuration of the Irish Channel and the great mass of ice which had been proved to have occupied it. The fact was also alluded to that south of the Thames and the Bristol Channel the country bears no trace of having been submerged during the glacial epoch, and it was incredible that an actual depression of the land to such an extent should end so abruptly and should afterwards be replaced by an elevation, without any traces being left in the strata. Whatever difficulties attached to the explanation now suggested—and which arose altogether, Mr. Bell thought, from the height at which these shelly remains were found—there seemed to be far greater difficulties attaching to the theory of the submergence. He concluded by referring to the improbability of great oscillatory movements of the earth's crust in comparatively recent times, and quoted Darwin's aversion to "depressing or elevating mother earth" in order to favour any theory. The great naturalist's caution in this respect, and his patient attention to other causes, had been richly rewarded, and it could not be doubted that these were the right lines to follow in endeavouring to read aright this interesting portion of the history of our globe. The paper was illustrated by a number of maps, sections, and diagrams. Remarks on various points raised were made by Messrs. John Young, F.G.S., Wm. Jolly, F.G.S., H. M. Cadell, F.R.S.E., Steel, and James Thomson, F.G.S., and after a cordial vote of thanks the Society adjourned to the evening of Thursday, 30th May.

HULL GEOLOGICAL SOCIETY.—On April 6th, the members of this society made an excursion to Driffield, in order to inspect the admirable museum of Mr. J. R. Mortimer, which contains a splendid and unique collection of chalk fossils of Yorkshire. Before examining the cases an address was delivered by the Rev. E. Maule Cole, M.A., F.G.S., a vice-president of the society, and president of the Geological Section of the Yorkshire Naturalists' Union, on the cretaceous rocks of Yorkshire. After describing the physical features of the Wolds the lecturer rapidly sketched the order of the various beds, and the localities where they might be studied. The following is a brief summary. The chalk of Yorkshire extends from Flamborough Head westwards to near Malton, then southwards to Hessle. It underlies the whole of the plain of Holderness, which is covered superficially by deposits of boulder clay and drift, thinning out against the eastern margin of the Wolds. The upper chalk, without flints, extends south-west from the south landing at Flamborough in a narrow band to Sewerby, thence by Burton Agnes and Kilham to Wetwang. The middle chalk, with flints, constitutes the high ground of the Wolds on the north and west. The lower chalk, without flints, consisting of grey chalk and chalk marl, is divided from the middle by a band of black chalk, decidedly carbonaceous, from 1 ft. to 3 ft. thick, which may be seen in the Speeton Cliffs, at Goodmanham, Drewton, and Melton. At the base of the lower chalk occurs the red chalk, or Hunstanton limestone. It forms a conspicuous feature in the cliffs and on the shore at Speeton, and may be traced on the outer margin of the Wolds throughout, reaching its highest elevation (500 ft.) above the sea level at Acklam Brow. The line of red chalk is also the line of springs, the chalk resting on various beds of impervious clay. The above divisions constitute the upper cretaceous rocks: the lower cretaceous are developed only in the Speeton clays—a marine formation answering to the Wealden clay and Hastings beds of the South of England—which may be studied with interest and advantage at the south end of Filey Bay. After inspecting the superb collection of chalk fossils, the party turned their attention to the archæological department, which is probably the finest and largest collection from

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one locality in existence, including, as it does, the relics of 300 British tumuli, 200 Anglo-Saxon graves, with numerous weapons and ornaments of bronze, and literally thousands of flint and stone weapons of all descriptions, gathered from the surface of the Wolds.

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LEEDS GEOLOGICAL ASSOCIATION.—Under the auspices of this association a lecture was recently given, at the Leeds Philosophical Hall, by Mr. A. S. Woodward, F.G.S. (of the Natural History Department of the British Museum), on the subject of "Old Bones." The lecturer observed that when an animal possesses any hard parts it is generally possible to form some idea of the character of that creature, even when nothing but its skeleton can be examined. The interpretation of the features of the skull is especially important, because the head will nearly always give more idea of the true character of an animal than any other part. One prominent feature has only been interpreted within the last two or three years; it is a little hole in the top of the head, opening into the brain cavity, commonly met with in living lizards, but especially large and prominent in many extinct reptiles. In the living lizard the hole is occupied by a rudimentary eye, and there cannot be much doubt that many of the reptiles of old times had an actually useful median eye upon the top of the head. The study of dry bones gradually developed into an important branch of natural history. Baron Cuvier, the old French naturalist, had made restorations which have been proved by later discoveries to be remarkably accurate, and the enormous advance in such studies made by this naturalist is rendered all the more conspicuous when it is remembered that, not long before his time, a fossil salamander from Switzerland was described as the skeleton of a child that had perished in the Deluge. Cuvier had many distinguished pupils, and most distinguished of all, perhaps, is our own Professor Sir Richard Owen. He has spent more than fifty years in applying and extending the principles of his great teacher, and his first remarkable success was the discovery of the huge extinct wingless birds of New Zealand. Before any of the Maori traditions of these birds had reached England, Professor Owen had satisfied himself that such creatures must once have existed, merely from the examination of a single fragmentary thigh-bone. However, the more the modern discoveries of natural history are studied, the more evident does it become that the bones of extinct animals cannot always be interpreted merely by reference to those of creatures now existing. The bones of flying reptiles, for example, are hollow, and many of them very like those of birds, so that before the complete animals were known they were often actually referred to as birds. Some very ancient three-toed footprints in North America were also for a long time supposed to have been made by birds, but it is now known that they are really the tracks of extinct reptiles which walked on their hind legs. Many mistakes were also made before it was recognised that huge land-reptiles once existed, in which it was requisite for comfortable locomotion that some of the bones should be hollow and made light by hot air, like those of birds. So many complete fossil skeletons, however, are now known from all parts of the world, that the science of fossil bones is gradually becoming far from guesswork and imagination. Many of our existing animals can now be traced back almost to common ancestors, which do not exhibit precisely the characters of any of their descendants, but combine in their structure the fundamental peculiarities of all of them. Moreover, the work of "old fossil bone-setters" has shown that existing animals do not give the faintest idea of the diversity of modifications of which each main type of structure is capable. The possibilities of animal organisation seem so boundless that the novelties of the next discovery can never be predicted.

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LIVERPOOL GEOLOGICAL SOCIETY.—EXCURSION TO ANGLESEY.—A small party of the members of this society took advantage of the Easter holidays to make an excursion to the Isle of Anglesey for the purpose of examining the older rocks, so well displayed in that district, and which have been the subject in late years of so much discussion among geologists. Mr. T. Mellard Reade, C.E., F.G.S., led the excursion, the head-quarters of the party being fixed at Bull Bay. Three days were devoted to an examination of the north coast, from Yr-hen-borth, East of Camlyn Bay, to Point Ælianus, a distance of about 10 miles in a direct line, but, in consequence of its sinuosities, perhaps double that distance along the coast. Commencing at the east at Yr-hen-borth, the rocks consist of purple and green slaty beds, having a low dip in a north-easterly direction. The bedding and cleavage seem to be nearly coincident, and the beds are penetrated with igneous dykes and sheets, some of the latter being exceedingly thin and numerous, following the line of bedding At Cemmaes Bay the dips increase and the strata become more disturbed. At Porth Badric the Cemmaes limestone occurs, having a crystalline structure, and containing no fossils. Further on are black shales of a different nature, let down among the main crystalline rocks; these are considered to be Ordovician. Between Porth Badric and Porth Wen occurs a very interesting purple quartzite conglomerate, which, in one exposure, looks more like a breccia. The quartzite pebbles and fragments are cemented with a matrix of volcanic ash, which has a foliated structure. One of the remarkable features of this deposit is the presence of veins of white secondary quartz, which intersect pebbles and matrix alike. At Porth Wen is a quarry worked for "China stone." The coast from this point to Bull Bay is rugged and interesting. At Bull Bay the strata consist of green, gray, and purple schists, some of extreme hardness, and having a high northerly dip, until, at Point Ælianus, these rocks become contorted in the highest degree. Some of these contortions, which are the representatives of the more parallel schistose bedded structure further west, are extremely interesting, and have been likened to "damascene" work; when properly cut they form very interesting slides for the microscope. There has evidently, at this point, been a giving way and squeezing together of the constituents of the rock. The rocks in this area are now generally considered to be of Archæan age; they are the "slaty series" of Callaway, and "Middle Monian" of Blake. Sir Andrew C. Ramsay considered that none were older than the Cambrian, and on the Geological Survey Map they are coloured as Cambrian and Silurian. Since the survey was made, however, much information has come to light. The general opinion of the members, after going over the ground, was that the whole of the older rocks of Anglesey require re-surveying in the light of later discoveries. The last whole day was devoted to a traverse of the rocks from Amlwch to Moelfre, which had to be done by help of "horse power" there and back, stopping at points of interest for examination. Driving south-easterly from Amlwch we pass in succession over the crystalline schists and Silurians, until at Dulas Bay we reach the Old Red Sandstone, of which there is a very interesting exposure in a small quarry on the left of the road. At Penrhos Lligwy, the base of the carboniferous, consisting of a white quartz grit, is exposed in a quarry. Some good specimens of slickensides, showing the cleavage and polishing of the small pebbles or grains, were here obtained. Further on at a higher level a quarry in the carboniferous limestone was visited, and on the coast South of Moelfre, the Penlleth quarries, now extensively worked for use in connection with the Manchester Ship Canal, afforded a couple of hours' pleasant hammering and sketching on a lovely afternoon. Here the scarped faces of the limestone could be seen succeeding one another, with a characteristic long low dip as far as Red Wharf Bay, with the more Alpine mountains of North Wales as an azure background. A walk over Parys' mountain and an inspection of the "ochre beds" formed part of this day's work, while a final hammering of the rocks at Bull Bay completed, next morning, an extremely pleasant and enjoyable scientific outing. The members were all workers, and enjoyed it all the more from the absence of the orations in explanation

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of the phenomena, which are necessary with the mixed audience that usually compose scientific pic-nics.

LIVERPOOL GEOLOGICAL ASSOCIATION.—At the ordinary monthly meeting, held on Monday, May 6th, Mr. A. Norman Tate, F.I.C., president, in the chair, several donations to the library were announced, including books and pamphlets from Messrs. J. C. Evans and W. Whittaker. Some fine crystallised masses of hematite and minetite from Cumberland were exhibited and described by Mr. D. Clague. A paper was read by the secretary, Mr. I. E. George, entitled "Notes on Some Manx Lavas." The author referred briefly to the microscopic structure of a dolerite from Langness, showing, as a result of slow cooling, well-developed crystals of felspar, and having these crystals arranged without any definite order. A comparison was then made of the more acid lavas of Scarlett Point, in which the very small felspar crystals, indicative of rapid cooling, had a general drift in one direction. This "fluidal" structure is very common in lavas, being impressed upon the rocks when they cooled from a liquid state, after flowing a certain distance from the volcanic vent. A striking feature of the Scarlett lavas was the prevalence of a vesicular structure, whilst the occurrence of angular blocks of the same lavas in an agglomerate, forming a part of the series, confirmed the impression that the various materials had been accumulated at the surface. Microscopic sections of these rocks showed that the original vesicles had in every case been filled with material at a latter date, forming amygdules. Occasionally, there might be seen zones of different materials (silica and carbonate of lime) within one vesicle, but, as a rule, the filling was entirely calcareous. The different modes of arrangement of the infiltrated materials were then discussed, as being probably illustrative of different stages in the history of underground circulation.

WHITEHAVEN SCIENTIFIC ASSOCIATION. — At the concluding meeting of the session 1888-9, held at the Institute, Howgill Street, Dr. Jackson, the president, occupied the chair. The secretary (Mr. Russell) read the following report:—"After twenty-two years of varied success the committee are still in a position to say that, although during the past year the members have not so actively supported their efforts, the affairs of the Association are very satisfactory. The usual *conversazione* opened the proceedings at the beginning of the session, 1888-9. Besides the *conversazione* and the general meeting, nine ordinary meetings have been held. At each of these papers were read of much interest, both generally and locally. The committee, however, much regret that the attendance at these ordinary meetings has not been so large as it ought to have been. The society numbers 225 members. During 1888-9 15 new members have been elected. There are now 45 associate members and 180 ordinary members on the register, a slight decrease upon last year. Dr. W. I'Anson reports that several valuable specimens have been presented to the museum during the past year. Mr. R. Pickering also certifies that the buildings are in a satisfactory state of repair. The hon. librarian says that the library has not been so much patronised as in former years, and that only a few volumes have been added during the year. For the purchase of new books the fund now amounts to £5, and the committee propose that this amount should be expended very shortly. Science classes in connection with the Science and Art Department, South Kensington, for the teaching of mathematics and magnetism and electricity, have been taught by Mr. Freeman during the session. There has been a considerable increase in the number of scholars attending these classes during the present year, a circumstance which the committee regard with much satisfaction. At the examination in May, 1888, several first and second class passes were obtained in mathematics and other subjects. The members of the photographic section have held meetings from time to time under the guidance of Mr. R. Hellon, Whitehaven, and of Mr. W. L. Fletcher, Workington. The committee have approved of a scheme of Oxford Extension Lectures, for which Miss Corrie is appointed local secretary. Under the auspices of the association and the large and influential list of guarantors, together with the number of those who have promised to attend the lectures, the committee trust that the general support which will be extended to these lectures will amply justify this endeavour on their part to bring a great educational scheme within reach of every member of the association." The following officers were elected for the ensuing session:—President, Mr. T. Gordon; vice-presidents, Mr. G. Scoular and Mr. H. M. James; treasurer, Mr. J. S. Hellon; hon. secretaries, Mr. E. Dobson and Mr. E. R. Russell; auditors, Mr. W. M'Gowan and Mr. S. Broadbent; committee, Dr. Ablett, Mr. B. Taylor, Mr. E. Crompton, Dr. Hellon, Mr. H. Adair, Mr. G. Boyd, and Mr. R. B. Gordon.

LIVERPOOL ENGINEERING SOCIETY.—The thirteenth ordinary meeting of this society's present session took place at the Royal Institution, the president, Mr. Charles H. Darbyshire, in the chair. A paper was read by Mr. Thomas Morris, F.G.S., of Warrington, on "Some Causes of the Crystallisation of Iron." In the course of his paper, Mr. Morris said he had taken up the subject as the result of a former discussion as to the fibrous nature of iron. The crystallisation of iron had always been with ironmasters a question of great concern. Those unacquainted with the manufacture of iron believed that it was improved by repeated workings. This was not so, and he gave figures which showed that the strength of iron improved up to the sixth working, but that from the sixth to the twelfth working its strength as steadily declined. As the chief causes of crystallisation, he gave the influence of oxygen in the puddling process, over-heating, compression, percussion and frost, and silica. The latter material was especially present in the "cinder" pig iron now made and bought in large quantities, because, as containing a great deal of phosphorus, it was suitable for the Bessemer steel process. In discussing the effects of percussion in destroying iron fibres, Mr. Morris considered the matter in regard to railway wheels and axles, rails, and chains. With reference to the latter, he said that the tension of chains, and especially sudden jerks, tended to destroy the fibre of the links, and the result was that the chain, not being examined, broke when least expected. The damage was attributed to the chainmaker. He was not able to say that the impact of a cannon ball produced crystallisation. Common scrap iron when worked up again was crystalline, and breakages due to the use of it were often laid on the broad back of vibration.—At the fourteenth meeting the officers and council for the next session were elected, Mr. H. H. West being chosen president, and Messrs. J. J. Potts and F. Hudleston, vice-presidents. Afterwards a paper was read by Mr. C. H. Beloe, M. Inst. C.E., on the "Purification of Water and Sewage by the Magnetic Spongy Carbon Process." The purification of water was first dealt with, and the ordinary methods of sand filtration, which fail to remove decomposing peaty matters, the various processes of filtration by means of animal charcoal, Spencer's magnetic carbide, and Bischoff's spongy iron were referred to, and lastly, the process introduced by the International Water and Sewage Purification Company was described. A new material called "polarite," manufactured by the International Company, was then described, and samples were exhibited. "Polarite," it appeared, is an insoluble mineral substance, prepared from a peculiar description of carbonate of iron found in certain parts of South Wales. By its use the area and depth of filter beds may be considerably reduced as compared with the dimensions of sand filters, and all peaty matter may be removed from the water. Some interesting analyses were given, showing the high degree of purity obtained by passing water through polarite filters, notably the case of very foul water taken from the Grand Junction Canal at Willesden. The second portion of the paper was devoted to the purification of sewage. The numerous well-known methods of utilising sewage for irrigation and for the manufacture of

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manure were criticised by Mr. Beloe, and the "international" process was described. In this process Mr. Beloe said a magnetic precipitant and deodorant, called "terozone," was added to the sewage, which is allowed to settle in tanks. The liquid was then drawn off and passed through a polarite filter bed, which rendered it clear, bright, and inodorous.

The Migration of Birds.

AT the meeting of the Ealing Microscopical and Natural History Society, held on the 9th of March, the Rev. Professor Henslow, president, in the chair, an interesting lecture on "The Migration of Birds" was delivered to a large audience by Mr. H. Seebohm, F.Z.S., who in the course of his remarks said that of all subjects connected with ornithology, perhaps there were none more interesting than that relating to the migration of birds, and it was a subject which had only comparatively recently made any progress. In the old books on ornithology one found it gravely stated that birds were in the habit of hibernating in the same way that some of the smaller mammals, such as the dormouse and squirrel, did. But of all the theories they would find there was nothing too wild to be entered in books of science, and there was a grave account by people who were supposed to have watched the migration of swallows, and seen them in the summer spending nearly the whole of the time at their disposal on the wing, then gradually towards autumn being less and less upon the wing, frequently settling upon the roofs of houses or upon the window sills, or upon the bare branches of the trees, and finally collecting in enormous quantities on the banks of the Thames, and then, the next morning having suddenly disappeared, our wise ancestors came gravely to the conclusion that they had plunged into the mud at the bottom of the Thames, and would reappear the next spring with a new suit of feathers, in order to spend another summer with us. Another curious theory was that sparrowhawks turned into cuckoos in the spring. But by-and-bye, when it was discovered that the disappearance of a bird from our country was the signal for its appearance in some other, and birds were actually seen in the act of migration at Gibraltar and many other points, and when captains of ships out at sea met with troops which settled in the rigging, then migration ceased to be a theory and became an accepted fact, although it had been known from time immemorial that birds disappeared. There were apparently three kinds of migratory birds. We had birds which came here in the summer, such as the swallow or the cuckoo; and then others which came here only in the winter, such as the fieldfare, Jack snipe, and many others; while a few birds were only seen for a few weeks in autumn, and again for a few weeks in spring, migrating from breeding grounds further north to winter in the south.

We saw them here only in the process of migration. If any of them would take the trouble to go to the southern shores of England, say to the Brighton Downs at Shoreham, or Newhaven, there they might see large quantities of birds in the act of migration. When one first got there, if it happened to be a fair day for migration, he would see birds flitting here and there, and it would not occur to him that they were migrating. He would think they were wandering up and down the coast for amusement, or in search of food; but, if one still watched them carefully, he would see that the birds which were moving from west to east—that was to say, from Cornwall towards Dover—were thin-billed insect-eating birds, who, in the autumn, were migrating eastwards, in order to cross the Straits of Dover, and to winter in some southern latitudes. The birds, on the other hand, which were moving from east to west, were for the most part hard, thick-billed, insect-eating birds, who had brought up a family in Norway or Denmark, and who had crossed the German Ocean, perhaps to the coast of Norfolk or Lincolnshire, having come here for the purpose of spending the winter, our winters being so much warmer. As to the extent of this migration, he found by inquiries of the bird-catchers that one man had been known to catch as many as 3,000 greenfinches in a fortnight, and it was by no means an uncommon thing in a favourable season on a favourable day for one man to catch 500 linnets in one morning. A hard winter in Scandinavia would drive the birds here in enormous quantities, and sometimes in great variety. One of the birds occasionally appearing in enormous flocks was the Bohemian wax-wing, which bred in Arctic regions, and only came here when the winters in those southern parts just below the Arctic circle were extremely severe. One of the great laws was that birds breeding in the tropics never migrated, being always resident—that was to say, that if they did migrate, their migrations were simply confined to ascending the mountains to breed in spring, and descending again into the plains in the autumn. These were for the most part birds with very rounded wings, and migratory birds had generally very pointed wings. Another of the laws of migration—not quite so definite as one could wish, and a very disputed point—was that where the breeding range of the bird over-lapped its winter range, in the over-lapping portion it did not migrate. It was a point of difference whether the woodcocks, which bred in this country, when they had finished breeding, migrated, or remained here all the year round. But there was strong evidence that they did remain in this country, although for a month they were hardly seen, because at the time when birds are moulting they skulk and hide to such an extent that one might very easily imagine they were absent. But the great law of migration was that all birds breed in the coldest parts of their migrations. The further north a bird breeds in the summer, the further south he winters; and the probable reason for this was that birds endeavoured to find in winter a climate as near their summer climate as they could. The cause of migration was no doubt want of food.

Birds did not migrate because it was cold, as they were able to provide themselves with warm coverings; and some which winter in Siberia were absolutely covered with feathers and down to such an extent that they were able to endure 60 or 70 degrees below zero without suffering any harm; but of course they were only birds which could find food upon the trees and other places where it was not covered up with snow. There was, no doubt, an immense amount of mortality in migration. A great many birds lost their way; some were caught in storms; others got in the wrong stream of migration. And if there was not this great mortality the world would get so full we should not know what to do. If they were to start in a neighbouring field, say with a pair of partridges, and they were to lay 18 eggs—which was not an unusual number—and they and their descendants lived for 16 years without any deaths, and each pair were to go on producing at the rate of 16 birds a year, at the end of 16 years the produce of that single pair of partridges would be so numerous that the descendants would be unable to stand upon the surface of the earth, including the sea, without standing upon each other's backs. The migration of birds could be best and most thoroughly studied at Heligoland, and here there had been more different kinds of birds shot than in any country in Europe. The island lay in a great route of migration, and many birds were captured there.

The lecturer now proceeded to relate how Gaetke, a German artist, who went to Heligoland to study the waves, married and settled down there, and about 30 years ago having his interest aroused in ornithology, made it a point to watch all the birds that were caught there, so that his observations had proved most valuable to ornithologists. He (the lecturer) stayed at the island a month once, and during the first week saw many interesting birds. But during a fortnight or ten days he hardly saw a bird. Upon telling Gaetke this on

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day he told him to go to bed early that night as to-morrow the island would be full of birds, the wind having changed, and with that change came a large number of migratory birds. About eleven or twelve o'clock the same night he was awoke, and upon getting up found the island full of birds, and the Heligolanders up, with belts round their waists with lanterns attached, and nets, by which means they caught all sorts of birds. He made his way to the lighthouse, and when he got up to the balcony a most interesting sight was presented, for overhead were flying one dense mass of birds rushing upwards as fast as their wings could carry them, and whistling as they went; and perhaps one in a thousand would be attracted by the light and flutter towards it, and possibly out of those one in a hundred would go so far as to settle on the wire netting, and these were caught very easily. In the course of three hours they secured over 200, almost all of them skylarks, and on one of those enormous migratory nights there had been known to be as many as 15,000 skylarks caught in one night by the Heligolanders. Here extracts were read from Mr. Gaetke's diary as to the kinds of birds which came to Heligoland, the numbers, and the months in which they appeared. The emigration of a species lasted about a month. In autumn the birds that had lived high up in the Arctic regions were coming down past Heligoland, and the first to arrive, and which came in great numbers during the week, were those which had been hatched in the spring, and which had consequently never migrated before. They started before their parents, generally led by one or two old birds who might be too old to breed, or who might have been unfortunate with their brood, and having nothing else to do had migrated with the young birds to point out the way for them. In the second week the males arrived, and in the third week the females, and the last week was taken up by crippled birds, who formed a most curious collection. There was no doubt that in migration birds had certain landmarks to guide them, and if one found a bird in England which ought not to have been here, it was almost certain to be a young bird which had never migrated before, and had lost its way. There was considerable dispute among ornithologists as to the routes of migration. Each species had its own route, and the route formed a sort of epitome of its past history. A couple of years ago he (Mr. Seebohm) was in Natal in February and March, and he saw hundreds of thousands of our common swallows just completing their moulting and ready to start to come back again to the North of Europe to breed. And there were on the south and south-east coasts of Africa numbers of British birds, such as the common sandpiper, grey-plover, ring-dotterel, &c., who would soon be migrating again. They had heard the old question, "Whence cometh the stork?" And if they wanted to know that, he might tell them that it came from Natal. At one time or another there must have been an immense amount of immigration among birds, and in some cases one could easily trace where the immigration had been. One of the most interesting cases was the immigration of Pallas' sand-grouse—a cross between a pigeon and a grouse—discovered a century ago by a naturalist of the name of Pallas, who found it breeding on the Mongolian Steppes. In 1863, thousands of these birds suddenly made their appearance in Europe a little latter than their ordinary time, and they spread over as far south as Spain; numbers got to Heligoland, many came to the British Isles. The birds, on arriving at their breeding grounds, found them covered with snow, and they had to rush away to try and find fresh breeding grounds. And the interesting circumstance was that this happened 25 years ago, and the same thing occured last year, when they spread in almost the same manner over nearly the whole of Europe and in Heligoland, as in their previous visits. After the lecture questions were asked by Mr. W. H. Harris, Mr. Simpson, the Rev. Percy Myles, and Mr. J. Allen Brown, and answered, and the proceedings concluded with a hearty vote of thanks to Mr. Seebohm for his lecture.

Reviews.

Liverpool Chemists' Association. 39th Annual Report, 1889.

THE report of the work of the past session of this society shows that some valuable papers have been read, amongst which we note one on the "Origin of Petroleum," by the president, Mr. A. H. Samuel, and one on "Tabellæ and Pastilo," by Mr. H. Wyatt, jun. The council state that the amalgamation of the late Liverpool Registered Chemists' Trade Association has proved very advantageous in strengthening their association numerically, and extending its sphere of usefulness.

Yn Lioar Manninagh.

[No. 2. April, 1889. Ramsey: J. Craine.]

THE second number of the new journal of the Isle of Man Natural History and Antiquarian Society appears under a change of title, the present being, presumably, a more grammatical vernacular rendering than *Yannin Lioar*, as formerly printed. The contents are very readable and interesting, and include papers by Mr. P. M. C. Kermode on "Tumuli on Snaefell," "Our Insect Enemies," and "An Ancient Canoe Discovered at Ballakaighen." Miss A. W. Buckland contributes an article on the monument known as "King Orry's Grave," comparing this evidently prehistoric burrow with other similar tumuli in Gloucestershire. There is no historic voucher for this tumulus being the grave of "King Orry." It belongs to the class of monuments known as "chambered long barrows." Another communication of archæological interest is that on "Manx Sun Dials," by Miss A. M. Crellin. The report of the society and address by the retiring president, Mr. J. M. Jeffcott, are also given in this number.

Glimpses of Erin. By Seaton and Alice Milligan.

[London: Marcus Ward & Co., Ltd. 1s.]

UNDER this title, in an illlustrated volume, are collected a series of sketches relating to the ancient civilisation and antiquities of Ireland, its history and social condition, with which are interspersed vivid descriptions of its scenery, especially that of localities off the beaten track of the ordinary tourist. The authors are decidedly to be congratulated on the result of their joint efforts. They have succeeded in producing a thoroughly readable little work, which, whilst being far more entertaining than any guide-book, will be found a handy and pleasant pocket companion during an excursion in the "Emerald Isle." It is not saying too much when we state that English tourists, when they do not visit Ireland, do not know how much they lose. The country is in reality something more than the battle-ground of political parties. It has natural and scenic beauties of its own, and possesses a wealth of native lore and archælogical history which, in some respects, exceeds in interest that of any part of Great Britain. But the country has suffered in more ways than one from neglect. "It only requires," say our authors, "the pen of another Walter Scott to make Ireland one of the most favoured tourist resorts of Europe. Scenery, traditions, all are here; the magic spell of a great writer alone is wanting."

We have much pleasure in calling attention to this really delightful little work, not only from considerations of the nature of those to which we have above made allusion, but from the scientific interest of the volume. Scattered through its pages, will be found a large amount of information of a scientific, and especially of an archæological character, which it would be difficult to meet with elsewhere in a similar compass. The chapter entitled "Druidism," tells as much as probably we know regarding the rites and customs of these ancient Celtic priests. It is not, however, alone with the past that the book deals, for the "glimpses" give the reader an insight into many of the present leading features ofthe country and the people.

Elementary Mathematics.

[Longman's Elementary Science Manuals.]

STUDENTS preparing for the first stage of the Science and Art Department's examination in mathematics will find this book well suited for their purpose, including, as it does, the whole of the subjects required. There are 134 exercises in geometry, with a key to their solution, and some useful hints on the analysis and synthesis of problems and theorems. In arithmetic, and algebra also, there are quite as many exercises as the

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student can work out in the time at his disposal, and the questions are representative ones. Two faults may be found with the arithmetical portion of the book—1st, reduction, mensuration, and the compound rules, involving, as they do, a knowledge of vulgar fractions, are introduced before the principles of the latter have been explained; and, 2nd, the unitary method is entirely omitted. These small defects do not detract from the general excellence of the book, and we can heartily commend it to teachers as a really useful text-book.

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The Standard of Value. By William Leighton Jordan, F.R.G.S., F.R.S.S. [London: Longmans, Green & Co.]

REVIEWERS are sometimes accused of obtaining the materials for their notice of a work entirely from the preface. In regard to the *Standard of Value*, even if this were the case, it would be somewhat ungenerous to taunt the reviewer, for out of the 167 pages the book contains there are no less than 76 pages of preface. That the work has been recognised as valuable is evident from the fact that it has passed through no less than six editions; to each of these there is a somewhat lengthy preface. The result is that these prefaces become rather monotonous, and the reader cannot but feel that it would have been better if—to use a Hibernianism—most of these prefaces had been put at the end of the work. They are for the most part a defence or elaboration of the arguments contained in the work proper, and we cannot but think it would be better first to put the reader in possession of the argument itself, and then give the criticism and rejoinder in an appendix. Mr. Leighton lays great stress upon the fact that the National Debt, having been contracted under a double standard and the interest being now paid under a single standard, has added greatly to the burden upon the taxpayer. Mr. Goschen's recent conversion scheme has no doubt partly remedied this, but the same argument applies to many other payments beside that of the British National Debt, and deserves serious consideration. It will not do to open our columns to "The Battle of the Standards," but we can recommend Mr. Jordan's work as a valuable contribution to an all-important subject.

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Sparrows and Farm Crops.

IN connection with this subject, which was referred to by Miss Halcrow in a letter published in our last issue, we learn from the *Leeds Mercury* that a representative of the *Herts Advertiser* has lately had an interview with Miss Eleanor A Ormerod, F.R.M.S., the consulting entomologist of the Royal Agricultural Society, to elicit her views on the sparrow as an enemy to the farmer; and the following are some passages from the conversation which ensued:—

"It is not true," said Miss Ormerod, "that I would have the house sparrow or the field sparrow exterminated. Nothing of the sort. But I would certainly have them kept within reasonable numbers."

"Do you not think rooks are also great enemies to the farmer?" we asked.

"Undoubtedly they do some damage," replied Miss Ormerod; "but they also do a great deal of good. A considerable portion of the mischief that is done by the rooks is in grubbing up the turnips to get to the insects beneath. We lose a certain amount one way or the other, either by the insects or the rooks, so I do not see that it makes much difference. The rooks do good ultimately."

"Much can be said on both sides in regard to both the rook and the sparrow," continued Miss Ormerod; "but when the rooks are not too numerous they are very useful to the farmer. My father held a good deal of property in Gloucestershire, and when the tenants complained of the damage done by the rooks he gave instructions to the steward to have the birds thinned out. Then there was rook pie all over the place; but I don't think it was always wise to clear out the rookeries."

"In an article to the *Standard* some time ago," we observed, "the following passage occurred with reference to sparrows: 'Even Miss Ormerod has taken up a hostile attitude; and now, having lost the countenance of a scientific lady who loves all creatures, both great and small—except, possibly, the wire-worm and the Hessian fly—it seems likely that a bird which shares with the rabbit the malediction of Australia, and, with the Colorado beetle, the hatred of America, will fare badly at the hands of the farmers.' Why have you been induced, Miss Ormerod, to take up that attitude?"

"I should wish the sparrow to be just as free and unmolested as any other bird; but I think, literally and truly, they are taking the hard-earned bread of the farmers. It seems to me proved by the harm they have done in America, Australia, and elsewhere, that it is an increasing evil. When the agricultural inspectors went over a portion of land in Cheshire, near to Birkenhead, they found that in one year one-third of the wheat crop had been destroyed by the sparrows. People think me very cruel for trying, as they say, to get the bird swept away: but put it in another way Supposing in a town we get all the carts laden with not one-third, but with one-fiftieth part, of the loaves of bread in the shops; we don't take those loaves to the hungry people, or to those who need them, but we fling them on to a neighbouring common. Then we are, as the Bible properly puts it, 'accursed,' literally so. But they let the birds—the sparrows—do it, and rail against me for urging the necessity of some protective measures."

"Do you think the sparrow is a greater sinner against the farmer than such birds as the robin?"

"Oh, yes," came the reply instantly; "much greater. The sparrow is a gregarious bird; and, besides going about in flocks, and laying tribute on the farmers' and gardeners' crops at every season of the year, sparrows certainly eat much more corn and other produce than they do of insects. On the other hand, the robin is more partial to the flesh of insects, or to meat."

"In the *Manchester City News*, a few weeks ago," we said, "Mr. William Worthington, of Wigan, contributed a letter to a discussion on the subject of farmers and sparrows. Thirty or forty years ago, he said, the sparrow was not the only bird on whose head a price was put by the farmer; but all the hard or thick-billed birds, such as the bullfinch, chaffinch, greenfinch, yellow-hammer, and black-headed bunting were included in the list of 'farm pests,' and were ruthlessly destroyed the year round. Can you adduce any reason why the same war is not waged against the bullfinches or other birds now, beyond the fact that for some reason they are getting scarcer? Of course they will individually be as destructive now as then."

"That," returned Miss Ormerod, "is instancing an old saying. One unwise man may ask a question that it would take many wise men to answer. One thing to be remembered is that the sparrow multiplies so excessively rapidly, and is so gregarious. The finches are gregarious to a certain extent, but they don't do the amount of mischief that the sparrows do, and they do a great deal of good in eating insects. However numerous the finches may be you never see them in clouds in a field, as I have seen sparrows in fields near London, and do such damage as I have known to be done. The sickle was never put into a certain field of corn one year through the exceeding great damage done by the sparrows."

"If the destruction of sparrows became general," we asked, though almost knowing what the answer would be, "would it not very seriously deteriorate the beauty and value of our country lanes, inasmuch as it would probably affect the singing birds also?"

"Many of the singing birds," replied Miss Ormerod, "are already driven away by the sparrows. The songsters are not nearly so numerous as they were; and while existing rules apply to the protection of the sparrow—which has nothing now to fear from the hawk, the sparrow-hawk, or other bird of prey—the depletion must continue."

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Letters to the Editor.

HONOURS IN NATURAL SCIENCE AT OXFORD.

DEAR SIR,—Your "Notes in Brief" of the May number contain a statement that the only candidate in the school of Natural Science at Oxford this year will be a woman, and that special arrangements will have to be made with respect to her examiner. This, as it reads, will damage the Science School of Oxford University in the eyes of those whose knowledge of it is derived from your columns. The average number of men who take honours in Natural Science at Oxford is 25 a year. I do not know the exact number that will present themselves this year, but probably no less. The misunderstanding is, however, obvious; you doubtless intend to refer to one small section of the school, viz., Animal Morphology. In this section, owing to the non-utilitarian nature of the subject and the long preparation needed, there are usually few students.

The ladies now studying in the Morphological Laboratory work under the same conditions as the under-graduates, except that they are permitted a longer time to prepare for the examination if they wish. They will no doubt be examined in the same way as the men. In any case, why special arrangements should be necessary, or what they can be, I fail to understand. B. A.

New College, Oxford, 2nd May, 1889.

[*Note by the Editor.*—We thank our correspondent for his correction. We gleaned our information from a source we had reason to believe correct, but the misunderstanding is obvious.]

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BIRDS DESTROYING FLOWERS.

SIR,—That sparrows, and I believe chaffinches, and sometimes starlings, pluck the flowers of the yellow crocus has long been known. But the sparrow seems now to attack other flowers also. About a fortnight ago I noticed that the soil around some primrose roots in my garden were scattered over with flowers. At first I thought that cats or trespassing children had been in fault. But a few days later, looking out at my library window, I saw four or five sparrows hard at work. They tore off the corolla from each flower and threw it down without any attempt to eat it. I have since seen auriculas being attacked by the same birds; but here the entire flower, and sometimes the whole cluster of flowers and buds, is torn from the the stem and thrown down. Perhaps some of the readers of *Research* can tell how long this habit has been observed, whether it is confined to any particular localities, and what can be the motive of the birds. J. W. SLATER.

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ERRATUM.—In our article by Dr. McPherson on *Germicides for Consumption*, in our May number, page 192, line 9 from foot of page, "silicate of soda" should read *salicylate* of soda.

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A

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EDITED BY

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NOTICES.

In commencing the Second Volume of "Research" a new design for the front page of cover has been adopted, which we hope will prove acceptable to our readers.

With this number we give Title Page and Index of Vol. I.

Cases for Binding Vol. I., Price 2/-, or by post 2/3, may be obtained on application to Mr. E. O. Windel, 9, Hackin's Hey, Liverpool.

Bound Volumes, Price 5/-, or by post 5/6, can be obtained from Booksellers and News Agents, or from any of the Publishers. Only a small number of Volumes remain unsold.

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Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of news and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

To Our Readers.

IN commencing our second volume, we desire to tender our cordial thanks for the very encouraging support we have received during the past twelve months. The circulation of *Research* at its very commencement was sufficiently large to show that such a periodical supplied a much-felt want. This circulation has steadily and considerably increased; and the Journal now finds numerous readers in all parts of the kingdom, whilst several expressions of favourable opinion received from America and the Continent indicate that it is there read with interest also.

The very many contributions forwarded to us soon rendered it necessary to increase the number of our pages; but, even with this increase, we have to regret delay in insertion and the omission of many interesting communications. We trust, however, in the future to so deal with the mass of material at our disposal as to give insertion to all that is really valuable.

In selecting the articles that have appeared in our pages we have endeavoured not to give undue prominence to any one branch of science, but to make the Journal a record of general scientific progress and to stimulate research.

We are much indebted to the secretaries of various societies for reports of their proceedings, which we have endeavoured to print as fully as possible whenever they have presented matter of real interest; and, as we find that in various parts of the country there are numerous societies doing excellent scientific work, which is but little heard of, we wish still further to make our Journal an organ for disseminating all that is of value in the proceedings of such societies. We trust, therefore, that secretaries and officers who have not hitherto communicated with us will assist us with their reports in the future. We strongly desire not to represent one locality only, but to make *Research* of interest to scientific readers in all parts.

In our attempts to put before our readers descriptions of the various museums in different parts of the country, we have found that we were amply justified in the opinion expressed in one of our early numbers, that there exist in many museums objects of much value and interest that are little known; and in continuing our series of articles on "Local Museums" we hope to describe many of these, and cause them to be better appreciated.

Then, again, in giving attention to the "Scientific Aspect of Health Resorts," we have been particularly struck

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with the great opportunities afforded in many such localities for out-door scientific research which are too frequently neglected even by visitors of scientific tastes, but which, if made use of, could add greatly to the pleasure and intellectual profit of a sojourn in some of these delightful places. And, therefore, we intend to give many more descriptions of "Health Resorts."

"Our Portrait Gallery" has been the subject of interesting communications from many quarters; and, in continuing these portraits and biographical sketches, we hope to put before our readers the likenesses and biographies of men and women from all spheres of scientific life.

In short, the great number of favourable expressions of opinion we have received from various quarters, the satisfactory progress of the circulation, and the general success that has attended *Research*, encourage us to continue it upon the same lines that we have hitherto adopted; but we shall endeavour still further to increase our facilities for gathering information and obtaining articles and other communications of value, and try to lose no opportunity of putting before our readers that which can be of true service and interest to them.

Granite,

From a Geological and Economic Standpoint.

By J. Shearson Hyland, Ph.D., M.A.
(*Of H. M. Geological Survey of Ireland*).

Part II.

THE question of the origin of granite is the next point to be dealt with.

The igneous origin of granite was first demonstrated by the philosopher Hutton, and maintained by him against his rival Werner and his school during the celebrated controversy of the "Neptunists" and the "Vulcanists." Professor Haughton[1] has, however, shown that there are two great classes under which granites may be arranged, namely, *metamorphic* and *eruptive*. Thus, under the metamorphic series, he groups the granites of Scandinavia, of the Scottish Highlands (in part), of Donegal, Galway, and Newry; and under the eruptive series he places those of Wicklow, Down (Mourne Mts.), and Dartmoor. However, as it is doubtful whether metamorphic granite can be considered suitable for building purposes—though instances are known where such is the case—we will here confine ourselves to a discussion of the mode of origin of the true igneous granite. The latter generally makes its appearance in large masses and wall like sheets, occupying considerable areas, and extending for a great but unknown depth into the interior. Veins, or finger-like squirts, often branching and crossing each other, usually proceed from these masses, and are seen to penetrate the adjoining rocks, portions of which they mostly include. Such included portions have the appearance of having been exposed to a great heat, and their angles are usually worn as if through fusion. Upon the rock masses with which it is in contact the granites have also exercised a marked influence. They appear sometimes hardened, often they are split up, and a pronounced metamorphosis is discernible. To take a simple illustration: limestones are changed into compact, crystalline marbles, the organic remains originally present being at times so altered as to be no longer recognisable. This transformation of limestone into crystalline marble—termed "marmorosis" in this country—and the alteration of the included fragments can only be accounted for by the assumption that the granite was formerly in a state of fusion, and that it forced its way whilst in a molten or viscous state through the overlying rocks breaking off and splitting up fragments, which became either completely absorbed or only partially fused. It is possible by experiment to produce this "marmorosis" of limestone into highly crystalline marble. Sir James Hall, the friend of Hutton, was the first to show the truth of this, and his classical experiment has since been confirmed by those of the Germans, v. Richthofen, Rose, and Becker. As limestone and marble consist of carbonate of lime, it is essential to the success of the experiment that the CO_2 gas given off on application of the heat is not allowed to escape; hence, to obviate this, the several experiments were made in closed vessels.

The metamorphosis produced on its contact-rock by intrusive granite varies in kind, and is, of course, dependent upon the composition of the rock through which it is erupted. Most interesting is the formation of new minerals, such as garnet, andalusite, epidote, schorl, &c., in the adjoining sedimentary rock. The effect of the pressure and heat accompanying such eruptions are often to be observed over large areas. This portion of geology—the study of contact-phenomena—is not only one of the most interesting but also one of the most difficult to explain.

Many of the contact-phenomena can only be satisfactorily explained by the assumption that the molten mass (known as the *magma*) was saturated with water. The French geologist Daubrée has illustrated the property possessed by water of penetrating rocks in virtue of their porosity and capillarity, even against a considerable counter-pressure of vapour, and has proved by experiment the enormous mineral-forming power it can possess. The researches of Poiseuille have shown that the rate of flow of liquids through capillaries is augmented by heat; hence we must regard water as a powerful geological agent. When, then, percolating water comes into contact with molten material, it is unable, owing to the high pressure it is under, to convert itself into vapour, and is, therefore, absorbed by the magma, which it may eventually saturate[3]. If such a magma ascend till it arrives at an atmosphere of lesser pressure an explosion will probably occur, and the molten mass may either be transformed into volcanic ashes and vapour, or it may reach the surface of the earth, and only give off the majority of its water on solidification. But water-vapour is not the only gas which escapes from a lava; a large number of other gases, such as hydrogen, hydrochloric acid, sulphuretted hydrogen, carbonic acid, nitrogen, &c., are also very frequent. When, then, a lava charged with such vapours arrives at the surface of the earth the larger portion of these escape, and, as they burst through the molten mass, carry portions of the lava with them. The lava then solidifies either slag-like, vesicular and vitreous, or compact and only partly crystalline. If, on the other hand, such a molten mass cool off *under* the earth's surface, that is, under enormous pressure, the mass becomes granular and completely crystalline, and can only be exposed to our view through later denudation. Under the latter conditions granite is supposed to have consolidated, and hence such rocks are termed "plutonic."[1]

Professor Judd and other geologists have shown that the amount of glassy material present in any igneous rock is in inverse proportion to the amount of pressure under which it consolidated. Sections of granite examined under the microscope show, in fact, no trace of glassy

[1] *Journal of Geol. Soc. Lond.*, vols. xii. and xviii.

[3] cf. Angelot. "Note sur la cause des émanations gazeuses provenant de l'interieur du globe," in the *Bull. de la Soc. Géol.* (1) xiii., 178.

[1] cf. Cotta. *Geologie der Gegenwart*, 1866. xx.—Judd. *Geol. Mag.*, 1875. ii., pp. 10, 24, 76, and *Quarterly J. Geol. Soc.*, 1874, p. 240, and *Ibid.* 1885, i., p. 354.
Reyer. *Physik der Eruptionen*, 1877, 132-146.
Reusch. *Ueber Vulkanismus*. Berlin, 1883.

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material; the molten mass has been transformed into a completely crystalline rock devoid of base, as the uncrystallised residue of the magma is termed by petrologists. The quartz appears to be swarming with vesicular spaces, containing fluid matter, and possessing bubbles of air or gas. These are the so-called *liquid enclosures*, and consist partly of water, partly of liquid carbonic anhydride. Highly magnified, these minute bubbles may be observed to be in motion, sometimes slowly pulsating from side to side or rapidly vibrating like a living organism. In many of the quartzes such inclusions are so numerous that many millions must be contained in a cubic inch. The bubbles are considered as being the result of the diminution of volume consequent upon a reduction of temperature after enclosure, and, as Sorby has pointed out, this phenomenon is also apparent in artificial crystals, and may, indeed, be imitated. These liquid enclosures are specially typical of the quartzes of granite, and are interesting as showing that during the time the quartz formed there were present water-vapour and carbonic anhydride, which were then taken up as the crystalline matter came together. A slight application of heat (such as that afforded by the end of a burning cigar) to a section of such a specimen is often quite sufficient to cause the bubble in those inclusions containing CO_2 to be absorbed and the liquid matter to become gaseous. Upon removal of this heat the bubble appears again, and the gas becomes liquified. The presence of such inclusions in the quartzes is, accordingly, another argument in support of the theory that granite consolidated under enormous pressure.

Granites are acid rocks, that is, they contain over 50% of silica. As showing the chemical composition, the following analysis has been chosen :—[1]

Silica	72·07
Alumina	14·81
Peroxide of iron	2·22
Lime	1·63
Magnesia	0·33
Potash	5·11
Soda	2·79
Loss by ignition	1·09
	100·05

The specific gravity of the granite the analysis of which is given above was 2·66.

(To be continued.)

Aerial Propulsion of Ships.

By Richard Holland.

AERIAL navigation to ships is closely allied to the subject of the article on "Aerial Navigation," which appeared in our February issue; indeed, it is but one of the practical applications of the scientific truths discussed therein.

For long ages mankind were satisfied with the employment of the two motive powers, wind and water, the commonest applications of which were the wind-mill and the water-wheel. The discovery of the great motor—steam—that was to supersede these proverbially fickle moving powers and revolutionize in an incalculable degree the industries and commerce of the world is shrouded in obscurity; but it would appear that the first authentic application of steam to a really useful purpose dates from 1655, when a steam apparatus, invented by the Marquis of Worcester, raised a column of water to the height of 40 feet. Prior to this, however, a Spanish captain—Blasco de Garaz by name—is accredited with having exhibited in the harbour of Barcelona a small steamboat of his own invention. It is very probable, though, that Blasco's engine was on the principle of the Aelopine of Hero, invented 130 B.C., in which steam produced rotatory motion by issuing from orifices, in much the same way as the reactionary influence of the water in Barker's water-mill produces motion.

[1] A. Geikie. *Geology*, p. 138.

It was not, however, until the researches of James Watt, in 1777, that steam became an efficient motive power. Eleven years afterwards William Symington produced a really serviceable steam-propelled vessel, named the "Charlotte Dundas." It is rather significant to remark, *en passant*, that a vessel bearing the same name has just been launched in America, which its inventor anticipates will supersede steam. Tubes of compressed air and gas are discharged under the water, and the reaction of the fluid they displace gives a forward impulsion to the boat. The connecting links between the galleys of the Greeks and Romans and our present side wheel steamers would appear to be the employment of revolving paddles instead of oars. Wheel boats propelled by oxen and horses, or men, were well known to the Romans, and no doubt suggested the sequence of experiments as to the application of steam, which culminated in the final success of Symington in 1788. From the time of Symington to the present, steamships have advanced towards perfection by such rapid strides that America is but severed from England by a week's journey.

Sir Frederick Bramwell, the president of the British Association, has very effectively illustrated the mighty triumphs of steam as evidenced in our modern steamships. Comparing the galleys of old, driven through the water by human labour working at the oars, with the Atlantic liners of to-day, he shows that to the work effected by the engines of a vessel of 19,500 horse power it would be necessary to employ at the oars 117,000 men, and of course a reserve of that number would have to be in readiness to relieve the former gigantic gang. But, even supposing it possible to accommodate such an immense host on a vessel somewhat under 600 feet in length, he points out that by no conceivable means could their power drive the vessel at a speed of 20 knots per hour.

As in the past, improvement after improvement has been improved away, and invention has superseded invention, it may be that at no very distant future our present means of propelling ships through the water may be considerably modified, or perhaps relegated to the ranks of the superseded to make way for some more simple and effective methods.

While the scientific aeronauts of London, Paris, and America have been devoting their energies to discover a motor so light as to solve the problem of travelling through air, either by propelling the suspended balloon through the atmosphere, or, better still, by enabling its very suspension to be attained by mechanical means, a Dane—Mr. H. C. Vogt—has been engaged in perfecting his method of propelling ships by means of propellers revolving in the air instead of in the water. His invention is now patented, and will, if it fulfils the hopes of the inventor, revolutionize our present means of ship propulsion. On the deck of the ship a propeller is mounted, which is much larger and lighter than an ordinary water propeller. In a small vessel this air propeller would have to be some ten or twelve times larger than a screw revolving in the water, and capable of performing the same work. These air "screws," of which there may be two or more employed on the one vessel, have a wonderful resemblance to the wind-mill pumps used on board North American timber ships.* In addition to the propellant "screws" a smaller one is mounted near the stern of the vessel, and can, along with its framing, be swivelled literally round a pivot for the purpose of increasing the manoeuvring power of the ship, or for assisting the steering. The blade or wing may be made of one piece (thin sheet-iron is generally employed) or of more than one piece united together and overlapping each other. An aerial propeller revolving at a uniform velocity creates a vacuum in front of it, and the difference of pressure thus created produces a forward motion, similar to that due to an ordinary screw working in the water. In 1887, experiments made with a small boat fitted with an aerial propeller gave results which may, under the circumstances, be considered satisfactory. Again: a 5-ton screw boat made 7 3 knots per hour when steaming. Her screw was then unshipped, and an aerial propeller worked by her engines was

* See illustration on next page, for which we are indebted to the courtesy of Messrs. Cassell & Co.

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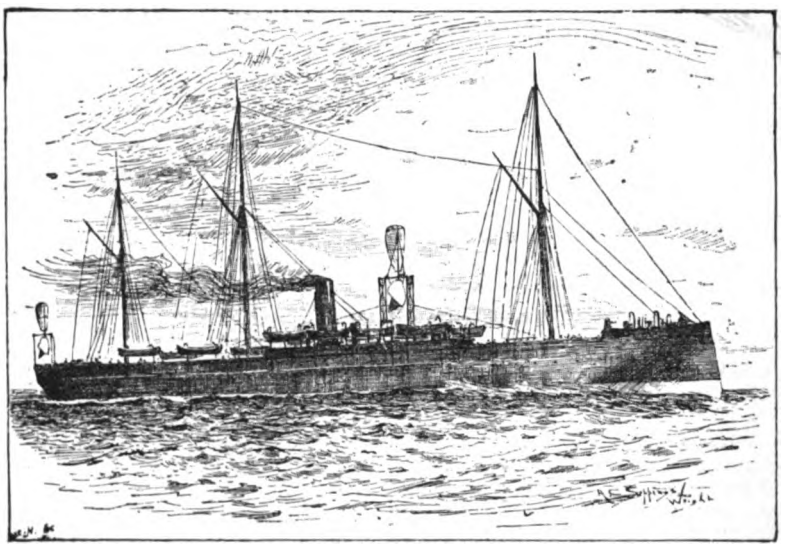
substituted. After undergoing some slight modifications a similar speed was attained. Official experiments made before the Danish Director of Naval Construction were similarly successful.

The advantages claimed by Mr. Vogt are—*(a)*. Economy of fuel. The power required to communicate a given velocity to a ship by means of the screw propeller revolving in water exceeds by 40 per cent. the power necessary to drive her when the air propeller is used. *(b)*. By reason of the steering fan at the stern of the vessel, and the fact that the propellant force is above the centre of gravity of the ship, it is much easier to alter a vessel's direction. *(c)*. The acute vibration so marked



upon an ordinary screw vessel will be obviated. *(d)*. The absence of a screw revolving in the water will ensure the hull of the ship offering less resistance to its passage through the supporting medium.

In ordinary screw ships the propeller, by sucking the sustaining water from the ship, causes its resistance to be augmented in the same proportion. The thrust of the ordinary propeller must, therefore, exceed the resistance of the ship by that amount. The faster the screw revolves the greater must be the resistance thus caused.

Should this system of propelling ships become feasible for large vessels, we may see a reversion to the old and more seaworthy type of craft As our large steamers are at present constructed, the ratio of length to beam is 10 to 1; but in the days when "cod's head and mackerel's tail" was expressive of the best then-existent models, the length but exceeded the breadth by about 4 to 1. Then ships sailed on the water instead of being driven through it, and travelling by sea, so far as greater immunity from *mal de mer* was concerned, was much more enjoyable. Ocean liners of to-day are built without keels or flanges that might protect their rolling, and this absence of a keel, though it may increase their speed, does not increase the comfort of the passsengers. For ships of war, however, or vessels fitted up as armed cruisers, or even any vessel in time of war, the aerial propeller is a decided disadvantage, it being evident that so much outwork would soon be shot away, leaving the ship that had only this system of propulsion to depend upon at the mercy of an enemy. Whatever may be the future of the invention, whether it will be assigned a place among the already existing methods of propelling ships, or whether it will be relegated to oblivion like many other brilliant but unpractical discoveries, it is certain that its present development will be keenly watched by all those interested in the great engineering question of the day, viz., how to obtain a maximum speed on a minimum consumption of fuel.

Diptera, as Spreaders of Disease.

By J. W. Slater.

THE two-winged flies, in their behaviour to man, offer a well-marked contrast to all the other orders of insects. The Lepidoptera, the Coleoptera, the Neuroptera, the Hymenoptera, the Orthoptera, and the Hemiptera no doubt occasion, in some of their forms at least, heavy damage to our crops. But they are not parasitic in or upon our bodies; none of them persistently intrude into our dwellings, hover round us when we take our walks abroad, and harass us with noise and with constant attempts to bite, or at least to crawl upon us. Even the ants, as a rule, do not act upon the offensive. The Hemiptera certainly include one semi-parasitic species which has reached a world-wide circulation, and one degraded purely parasitic group. But the Diptera, among which the fleas are now generally included, comprise more forms annoying to man than all the remainder of the insect world put together. These hostile species are, further, numerous beyond computation, and occupy every part of the globe. Mosquitoes swarm not merely in the swampy woods of the Orinoco or the Irrawaddy, but in the Tundras of Siberia, on the storm-beaten rocks of the Loffotens, and they are even encountered by explorers in quest of the North Pole. The common house fly was probably at one time confined to the Eastern hemisphere; but it accompanied the Pilgrim Fathers, and is now as great a pest in the United States as in Europe. It is curious, though distressing, to note the tendency of evils to become "international." We have supplied America with the house fly, the cabbage-white, the sparrow (at her own request), the small-pox, and the cholera. She, in return, has given us the phylloxera, the great cockroach (*Blatta gigantea*), a few visitations of yellow fever, and, climate permitting, she may perhaps throw in the Colorado beetle as a make-weight.

We find among the Diptera the habit of obtrusion and intrusion, of coming in actual contact with our food and our persons, combined with another propensity—that of feeding upon carrion and morbid and putrid matter of all kinds. Neither of these habits, taken singly, would be formidable, but in combination they are far more serious than we commonly suppose. If the fly—which at any moment may settle upon our lips, our eyes, or some abraded portion of our skin—were cleanly, its visits might occasion little beyond momentary annoyance. Or if it were the foulest carrion-feeder, but did not feel disposed to seek our company after its feasts, we might hold it, as some naturalists rashly do, a valuable scavenger.

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But I have already made too great a concession. So long as very many persons suffer from diseases—so long as the many of the deadliest or the most loathsome diseases are capable of being communicated from the sick to the healthy—so long must any creature which flies about and settles first upon one person and then upon another be a possible, or, rather, a probable, medium of infection and death. Everyone in these days knows that the so-called "zymotic" diseases, and probably others also, are propagated through the instrumentality of certain minute living beings, familiarly spoken of as "disease-germs." The secretions and excretions of the patients—human or brute—and after death their blood and their tissues, are found swarming with these "germs." If flies settle upon such matters, and then come in contact with our persons or our food, they are very apt to deposit there the infection. The amiable theory has been broached that the flies, by eating putrid and morbid matter containing these disease-germs, were rendering us good service. This is not the case. The flies certainly eat the filth, but the germs pass through their bodies in a living state, and have been found by the experiments of Drs. Manson, Grassi, Maddox, and M. Daraine fully capable of carrying infection. It has been noticed that in the Paris hospitals flies suck up greedily the matter expectorated by consumptive patients, and then deposit the germs of this disease, still in a living state, upon articles of food.

Let us take the following case, by no means imaginary, but a generalisation from facts which are only too well known:—A healthy man sitting at home or walking in the fields, especially in countries where the insect-eating birds have been foolishly shot down, suddenly feels a sharp prick on his neck or his cheek. Putting his hand to the place he perhaps crushes, perhaps merely brushes away, a fly which has bitten him so as to draw blood. The man thinks little of so trifling a hurt, but the next morning he finds the puncture exceedingly painful. An inflamed pimple forms and quickly becomes worse, whilst constitutional symptoms of a feverish kind come on. In alarm he seeks medical advice. The doctor tells him that it is a malignant pustule, and takes at once the most active measures. But in spite of all possible skill and care the patient too often succumbs to the bite of the *mouche charbonneuse*, or carbuncle fly. But has any kind of fly the property of producing malignant pustule by some specific and naturally indwelling power of its own? Surely not. The antecedent circumstances are these:—A sheep or a cow is smitten with the pest known in France as *charbon*, in Germany as *milz-brand*, and in England as *splenic fever*. Its blood, if examined, is found inhabited by microbia. If a lancet were plunged into the flesh of the animal, and were then used to slightly scratch the skin of a man, he would be inoculated with splenic fever. The bite of the fly is precisely similar in its action. Its rostrum has been smeared with the poisoned blood, a tiny particle of which is sufficient to include several of the disease-germs, and these are then transferred to the blood of the next man or other animal which the fly happens to bite. The disease is reproduced as simply as the spores of a fern give rise to their like if scattered upon soil suitable for their growth. But flies which do not bite may transfer infection. Every one must know that if blood be spilt upon the ground a crowd of flies will settle upon it and greedily absorb it. Now, animals suffering from splenic fever in the later stages of the disease sometimes emit bloody urine. Often such cattle are shot or slaughtered by way of "stamping out" the plague, and their carcases are buried deep in the earth. But some loss of blood is sure to happen, and this will mostly be left to soak into the soil. Here, again, the flies will come, charging their feet and mouth with the contagion. Such a fly, settling upon a beast or a man, and selecting—as it will certainly do, if such exist—a wound or a place where the skin is broken, will convey the disease.

M. Pasteur has thoughtfully pointed out that if an ox has died of splenic fever and has been carefully buried, the earth-worms may bring up portions of infectious matter to the surface, so that sheep grazing or being merely folded over the spot in question, may take the plague and die. Hence, he prudently counsels that the bodies of such animals should, by preference, be buried in sandy or chalky soils, where earth-worms are much less numerous than in clay-lands. A still better precaution is to burn the bodies, or to lay them in a tank of sulphuric acid, when the infectious matter would be destroyed, and the whole mass converted into a safe and useful manure. But, it may be asked, what has this to do with the fly question? Simply this, that if such worm-casts retain the slightest savour of animal matter flies will settle upon them, and will convey the infectious dust to the most unexpected places, thus literally giving wings to the plague. It is very true that no one has seen a fly feasting upon the blood of an ox dying or just dead of splenic fever, has then watched it settle upon some person and bite him, and has then traced the successive stages of the disease; but it is positively known that men have been bitten by flies and have then experienced all the symptoms of splenic fever, the place of the bite being the primary seat of the infection. We know also the eagerness with which flies will suck up blood, and we likewise know the tenacious vitality of most "disease-germs." Again: the greed of flies for purulent matter is not a thing of mere possibility. In Egypt, where ophthalmia is common, and where the "plague of flies" seems never to have been removed, it is reported as being almost an impossibility to keep these insects away from the eyes of the sufferers. The infectious matter thus taken up is conveyed to the eyes of persons still healthy, and thus the scourge is continually extended.

Another case, which seems established beyond all doubt, is the agency of mosquitoes in spreading elephantiasis. These "sanitary agents," as some sensational naturalists strangely term them, suck from the blood of one person the *Filariae*, the immediate cause of the disease, and transfers them to another. The manner in which this process is effected will appear plain if we reflect that the mosquito, the sand-fly, and all their allies do not simply "take from us a minute drop of blood." They begin operations by instilling into us a few drops of a fluid which alters the consistence of our blood, so that it may be the more easily sucked up.

Now, what is this fluid? The mosquito or gnat has spent the earlier or larval portion of its life living on putrescent organic—chiefly vegetable—matter. Of this material its tissues are built up and its fluids are composed; hence, just as the vulture exhales the odour of the carrion upon which it feeds, the mosquito gives off malarial poison in its secretions. I have repeatedly observed that the irritation from the bites of mosquitoes, gnats, midges and sand-flies, after subsiding, returns again on the third day. This is the best case; the worst is when the pest, before biting a healthy man, has steeped his sucking-tube in the poison of some virulent disease. Evidence is constantly accumulating to prove that mosquitoes are the chief agents in the spread of tropical fevers.

A word may be here said in answer to those theorists who maintain that but for mosquitoes tropical countries would be uninhabitable on account of unhealthiness by any animal higher than reptiles. 1. There is no unhealthy region in the world free from mosquitoes. 2. There are vast districts in Northern Siberia, Lapland, and the extreme north of America where malaria and tropical fevers are out of the question, which yet swarm with mosquitoes. 3. There are certain districts in South America where the waters abound in decaying organic matter, but which are free from mosquitoes and exceptionally healthy. 4. There are islands in the Pacific formerly and still healthy, and, until lately, free from mosquitoes, but into which these pests have been introduced by commerce. These facts should, I submit, satisfy any person who has been in the habit of regarding mosquitoes, sand-flies, &c., as sanitary. From what has been already established, it becomes wellnigh certain that every infectious disease may be and at times actually is propagated by the instrumentality of flies. Attention turned in this direction will go far to explain obscure facts connected with the

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distribution of epidemics and their sudden outbreaks in unexpected quarters. I have seen it stated that in former visitations of pestilence flies were remarkably numerous. Though mediæval observations in natural history are by no means to be taken without the proverbial "grain of salt," the tradition is suggestive. Probably the Diptera, like many other insects, have their seasons of unusual multiplication and spreading. A wave of the common flea passed through Maidstone in August, 1880.

We now see the way to some conclusions of no trifling practical importance. Recognising a very considerable portion of the order of Diptera or two-winged flies (at any rate the families *Culicidæ*, *Tipulidæ*, *Tabanidæ*, and *Muscidæ*) as agents in spreading disease, it surely follows that systematic war against them is a necessary part of sanitary reform. The destruction of the common house fly by *papier Moure*, by decoctions of quassia, and by the so-called "Catch 'em alive," is tried here and there, now and then, by some grocer, confectioner, butcher, or housewife angry at the spoliation and defilement caused by these little marauders. But there is no concerted and continuous action—which, after all, would be neither difficult nor costly—and consequently there is no marked success. Experiments with a view of finding out new methods of fly-killing are few and far between.

Everyone must occasionally have seen in autumn flies as if cemented to the window-pane and surrounded with a whitish halo. That in some seasons numbers of flies thus perish—that their death is caused by a kind of fungus (*Empusa muscæ*), the spores of which readily transfer the disease from one fly to another, we know. But here our knowledge comes to a fault. We have not learnt why this fly epidemic, or epizootic, as precisians would call it, is more rife in some seasons than in others. We do not know the best method of multiplying the *Empusa* at will, and of launching it against our enemies. We cannot tell whether it is capable of destroying midges, gnats, and mosquitoes. Experiments on these points are rendered more difficult by the fact that the fungus is rarely procurable except in autumn, when some of the species we most need to destroy are rarely to be found. Another grave question is whether the fungus, if largely multiplied and widely spread, might not prove fatal to other than Dipterous insects, especially to the Hymenoptera, so many of whom, by fertilizing flowers, are highly useful, or rather, essential to man.

I have experimented on the transfer of the fungus to other dipterous species, and with but limited success. Having found three common flies which had perished of this affection in the usual manner I carefully removed them from the window-panes to which they were fixed. On examination with the lens their bodies appeared covered with a very fine crop of the fungus. I placed them in a small vivarium and turned in three blow-flies, a *Stomoxys calcitrans* and two common house-flies in a healthy condition. Some sugar was supplied as food for the colony, and it was so placed that the flies in visiting it might be liable to come in contact with the dead specimens. All the prisoners came in frequent collision with the presumed sources of infection. The blow-flies especially walked over the dead, pushed them about, and touched them with their trunks. In course of time the two living house-flies became languid in their movements, took up their stations on the glass, and finally died in the usual manner, their bodies and the glass for some little distance being covered with a well-characterised growth of *Empusa*. The *Stomoxys calcitrans* died about the same time, but with less distinctly-marked symptoms. It did not become cemented to the glass, but was found on its back at the bottom of the compartment. Over its body there was a white fungoid growth, agreeing with that on the common flies, but much slighter. The blow-flies, on the contrary, which has taken much more frequent liberties with the infectious specimens than any of their fellow-prisoners, showed not the slightest trace of the disease. They buzzed about briskly whenever the sun shone, and died finally natural deaths. On holding a careful *post mortem* I could not recognise a trace of *Empusa* upon their bodies.

I resolved upon a more decisive experiment. I found two more house-flies which had just perished of the fungus disease, and, catching two lively blow flies, I applied the spores of the fungus to their bodies by means of a camel's-hair pencil, going over both the thorax and the abdomen, and especially the region about the spiracles. I then turned both blow-flies into the same vivarium, and observed what might happen. To my surprise they showed no symptom of the disease, and died after about a fortnight an apparently natural death. Hence it appears that, at least under the circumstances of the above experiments, this disease is not communicable to the blow-fly.

It may further be added that the infectiousness of *Empusa muscæ*, even among common house-flies, is not very great. The specimens which we find dead of this affection never form at all a large proportion of the flies infesting our houses. If we consider how these insects are given to touch each other, as if in some game, and how they crawl over those of their fellows who have fallen victims to the *Empusa*, we are led to wonder that the disease is not much more widely spread. Whether it may be possible, by any artificial cultivation, to render this fungus more plentiful and more actively infectious, it would be premature to decide.

Another fungus, the so-called "green muscardine" (*Isaria destructor*), has been found so deadly to insects that some authorities hope by its means to root out the phylloxera and the Colorado beetle.

Coming to better-known though still undervalued fly-destroyers, we have interfered most unwisely with nature. The substitution of wire and railings for live fences has greatly lessened the cover for insectivorous birds and for spiders. The increase of the sparrow has led to the decrease of some of our best fly-catching birds. The war waged against spiders in our houses is carried to extremes. Whatever may be the case in India, the Cape, or Australia, or even in Southern Europe, no British spider is venomous enough to cause danger to human beings. Though cobwebs are not ornamental, there are parts of our houses where they might be judiciously tolerated. The scarcity of spiders in large cities, even where their prey abounds, is something remarkable. The powder of the pyrethrum is not, as some persons imagine, a universal insect destroyer. It is very doubtful if such a specific exists, and, if existing, it would scarcely be desirable. The pyrethrum unfortunately acts most intensely and certainly where it is least needed. All the Hymenoptera, as far as known, succumb most readily; but this order includes so few of man's enemies and so many of his most valuable friends that we may well pause before attempting any general application of the pyrethrum powder to our fields and gardens. Hence, though the plant may be grown to advantage in most sub-tropical countries, we must not expect too much from its use.

Perhaps the most effective phase of man's war against the flies will be negative rather than positive, turning not so much on putting to death the mature individuals as on destroying the matter in which the larvæ are nourished. Or, since from other considerations we cannot destroy all organic refuse, we may and should render it unfit for the multiplication of these vermin. The means to this end are perfectly well known.

We see, in fine, that the two-winged flies form Nature's anti-sanitary service, the colporteurs of defilement, disease, and death.

M. G. Alessi (*Revue Scientifique*) has confirmed and extended the results of Grassi on the part taken by flies in the propagation of disease. Having fed flies on the matter expectorated by tubercular patients, he has detected the bacillus of tuberculosis in plenty in the intestines and in the excretions of the insects. The bacilli are alive and active, and if introduced into the tissues of animals they multiply and produce characteristic lesions. The microbia of cholera, of typhoid fever, splenic fever, etc., are likewise swallowed by flies, and after passing through their bodies, retain all their vitality and their virulence.

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Geological Photography.

By Osmund W. Jeffs.

In a recent number of this journal the art of photography in its modern development was shown to be of great service when applied to the study of the celestial bodies. It is not too much to say that, in the hands of experts like the Brothers Henri, Mr. A. Ainslie Common, Mr. Isaac Roberts, and the late Mr. Warren De la Rue, a new era has been opened in astronomical investigation by the aid of photography. There is one, however, amongst the physical sciences where the use of this art has not hitherto been brought into requisition to anything like the extent to which it might be usefully employed.

Geology is a science which especially needs ample and accurate pictorial illustration. In teaching the principles of the science good illustrations are essential, and, again, in describing the results of an investigation, faithful representations of the physical features studied are of no small importance. Such pictorial aid is not only required in text-books, the plates in which, being often drawn without due care, may give totally inaccurate ideas to students. It is equally useful in class teaching, where verbal explanations of geological phenomena should be supplemented by drawings and photographs from nature, whenever it is possible to obtain them. In the class-room it is often difficult to convey to the student the meaning of many geological terms in common use, such as, for instance, *outlier*, *unconformity*, *false-bedding*, *fault*, *dip*, and the like, the full significance of which can only be completely mastered in the field. The more frequent use of photographic representations of natural scenery and of certain important landscape features would greatly increase the value of the instruction given by the teacher. To take an example: if, when a "fault" is being explained to the class, a good photograph of a "fault," as it actually occurs, is exhibited, a more realistic impression is at once obtained.

In addition to these educational considerations, there are other aspects in which photography may be of great aid to geological science. In the course of time, from one cause or another, many familiar exposures of rocks disappear and sections are destroyed which illustrated, perhaps, principles of high scientific importance. Photographs of such sections, particularly of those which are typical or those opened temporarily during the progress of excavations, would often be invaluable, placing certain facts beyond all future controversy.

The camera and lens would enable the field-geologist to take rapid pictures of the sections of strata and localities of interest seen on his tour It may, possibly, be objected that the usual equipment of a practical geologist is already sufficiently weighty. The *impedimenta* comprising his outfit, described by Robert Dick as—

"Hammers and chisels and a',"

being numerous, it becomes a consideration of even more importance than to the ordinary travelling photographer to secure an apparatus of a light description. Suitable apparatus of a far more convenient and portable form than was formerly manufactured can now, however, be obtained at reasonable cost. Every geological exploring party should include amongst their number a scientific photographer, who would be under the direction of a competent geologist, and take pictures of those sections, &c., most desirable to be photographed.

At the last meeting of the British Association, at Bath, a scheme was proposed by the writer, by which it was intended to arrange for a collection of photographic views illustrating the geological features of each county. Such a collection, if systematically carried out, would preserve for us the pictorial records of many sections, quarries, cliffs, and important landscape features which would undoubtedly help to clear up disputed points, besides establishing facts as a basis of future work. The details of this scheme, with some other valuable suggestions, were incorporated in the Report of the Committee of Delegates of the Corresponding Societies, by whom the matter was discussed. It was decided that the delegates should endeavour to interest their respective societies, and that a preliminary list should be drawn up showing what had been done in this direction, with a view to the matter being carried out in future by a properly-appointed committee. By way of a "reminder," I addressed to the delegates a circular in almost identical terms with the letter which the courtesy of the Editor permitted to appear in the May issue of this journal, a copy being also sent to other geologists and local societies not officially represented on the British Association Committee of Delegates. The responses to this letter, and the communications received from geological friends, have shown that the idea has met with approval in many influential quarters, and the writer desires to thank those who have so encouragingly promised their co-operation in the scheme for the local photography of geological features. Amongst the societies which have already done good work in this way may be mentioned the Leicester Literary and Philosophical Society, Leeds Geological Association, Geological Society of Yorkshire, Belfast Naturalists' Field Club, Liverpool Geological Society, Chester Society of Natural Science, Croydon Microscopical and Natural History Society, East Kent Natural History Society, and others. Mr. S. A. Adamson, F.G.S., Secretary of the Leeds Geological Association, sends a list of local photographs taken, which is extremely valuable, and affords evidence that Yorkshire geologists are determined to make a good show for their county. Mr. Adamson states that his Council are fully convinced of the importance of the scheme, and adds that "it is a splendid idea, full of hope and value." Professor T. G. Bonney, M.A., F.R.S., thinks the idea "an excellent one," and offers some useful points for consideration in regard to the size and character of the views to be taken Mr. James Plant, F.G.S., of Leicester, has done excellent service in obtaining a series of really fine pictures of Charnwood Forest, and was one of the first in his encouragement to proceed with the scheme on a systematic basis. Professor Boyd Dawkins, F.R.S., also promises his valuable aid. Mr. Arthur Reid, M.A., Perth, expresses his interest in the matter, "both as a geologist and an educationalist," and has favoured me with several good prints from negatives taken by his brother, Dr. E. W. Reid, one of which—illustrating the famous "anticlinal," at Draughton—is here reproduced by his courteous permission. In the north, Prof. Lebour has long utilised the camera for the purposes of his geological work; in the west of England, Mr. W. W. Watts has taken some interesting views of Shropshire, and in many parts of the country much has been done which only requires to be systematized to be rendered of value to geologists generally. Several societies have expressed their willingness to help, but wish for directions how to proceed. In the present stage of the scheme it is not desired to lay down hard and fast regulations regarding size or uniformity of the photographs. These details can only be settled after discussion, when the Corresponding Societies have taken action in the matter and a committee has been appointed. In the meantime, however, it may be useful to mention the following points, which are important for the guidance of those who are interesting themselves in the matter:—

1. The size of the photograph should be not too small; "whole plate" size ($8\frac{1}{2} \times 6\frac{1}{2}$ inches) is perhaps the most convenient, "but this is not compulsory."

2. The photographs should be accompanied by the following particulars:—

(*a*) Name and position of section or locality.

(*b*) Illustrative diagrams, when necessary, with explanations of the features shown. (These details are most conveniently given on a tracing attached to the photograph.)

(*c*) Scale of height and length, and compass direction.

(*d*) Name of photographer, and society under whose direction the view is taken.

(*e*) Date when photographed.

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The views should be taken by a permanent process whenever possible. They should, in every case, be taken under the direction of a skilled geologist, and the most typical views should be secured in preference to general views.

In a future article I hope to be able to give a list of some of the most useful geological photographs taken by local societies, and I shall be glad to be favoured with as many particulars as possible from those who are willing to assist in the work.

QUARRY AT DRAUGHTON, NEAR SKIPTON, YORKSHIRE.
Showing "anticlinal" in Carboniferous Limestone.

(From a Photograph by Dr. E. W. Reid, 1888.)

Dr. Tempest Anderson has drawn attention to the use which may be made of these photographs as lantern slides, now so much used in lectures and for educational purposes. These slides can at any time be made from the original negatives taken, and the larger the negative the better chance there is of a good lantern slide being reduced from it.

Sufficient has now been said to show the adaptability of photography for geological research, not only in depicting rock sections, but in illustrating the work and effects of the sea, rivers, glaciers, and other denuding agents by which the surface of the earth is carved into its varied and ever-changing outlines of hill and valley.

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Museum Notes.

AT the British Museum, Mr. George Bertin has been delivering a course of four lectures of a very interesting character on "Babylonian Astronomy."

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A VALUABLE Report on Local Museums in Scotland has been drawn up, under the authority of the Society of Antiquaries of Scotland, by Dr. Joseph Anderson, keeper of the National Museum of Antiquities, assisted by Mr. G. F. Black. The report is the outcome of a jubilee gift to the society of £40 per annum by Dr. R. Halliday Gunning, the object of which was "to help experts to visit other museums, collections, or materials of archæological science at home or abroad for purposes of special investigation and research." The council of the society (who are constituted administrators of the gift) have the option of retaining the annual income in their own hands for a triennial period, according as the circumstances of the investigation may require greater or less expenditure than the income for one, two, or three years.

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THE managers of the principal museums on the Continent have taken advantage of the facilities in many cases afforded them for enlarging the experience of their own *employés* and officers by means of travel and inspection of foreign collections. Such a valuable aid to their training should nowhere be neglected, and it would be well if the necessary pecuniary means enabling local curators of museums to travel and report upon their observations were more widely provided. Many benefits would accrue from the practice. In the case of the Scottish Society of Antiquaries, the council resolved to lose no time in promoting the objects designed in the generous gift of Dr. Gunning, and they instructed two of their officers to visit several local museums, amongst which the following institutions were included:—Chambers' Institute, Peebles; Smith Institute, Stirling; Macfarlane Institute, Bridge of Allan; Alloa Museum; the Hunterian Museum, Kelvingrove and Anderson College Museums, Glasgow; Albert Institute, Dundee; Elgin Museum; Falconer Museum, Forres; Nairn Museum, and Inverness Museum.

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THE general results of this survey show that the archæological collections existing in local museums in Scotland are, on the whole, poor and fragmentary. The chief defects of these museums are thus summarised in the report:—(1) They are not sufficiently local in character, and (2) they have not been systematic in the formation of their collections. Each museum will be found to contain some valuable feature which only needs to be fostered and developed in a systematic direction in order to give the institution an outstanding individuality. But, in order to do this, energetic co-operation is required from a body of real workers who desire to make their museum a local commentary on the various sciences.

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GREAT stress is laid in this Report on the importance of instituting representative collections of local objects, and Dr. Anderson will have accomplished a lasting benefit to education if he succeeds in impressing this necessary action on the curators of all such institutions, whether in England or Scotland. "The true functions of local museums," writes Dr. Anderson, "are to foster the education of observation in their own districts by showing that all the natural sciences can be studied and illustrated from the local area, so far as the materials exist in them; and that these materials do exist in every local area, to an extent and in a variety of abundance which become surprising, when once they are made known by a systematically-arranged collection. It seems to have been forgotten that science is essentially local in its details, and that the basis of true scientific education must always be an intimate and exhaustive knowledge of its various materials as they present themselves in different localities."

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THE re-arrangement of the important Cooke collection of British Lepidoptera, bequeathed to the Liverpool Museum, has been completed by Dr. J. W. Ellis, F.E.S. Selected drawers from the collection have been exhibited from time to time at meetings of the Lancashire and Cheshire Entomological Society.

THE Thirty-sixth Annual Report of the Committee of the Free Public Library and Museum of Liverpool has been issued. The Report states that the issues of books in the reference library show a falling off of 2,000 in the department of prose fiction, indicating a greater proportionate demand for higher-class literature. The number of visitors to the museum during the year 1888 has increased from 255,616 to 291,754. Much improvement has been effected in the Mayer Museum by the labours of the curator in re-classifying, cataloguing, and labelling the specimens. The circulating Museum Cabinets continue to be received with favour by school teachers. A new Fish and Reptile Room has been opened, and several pictorial groups of birds, notably of penguins, have been mounted during the year.

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MR. HENRY HYDE'S Natural History Museum, at Ardwick Green, Manchester, has been the scene of several special visits from the different local societies of the district. The Geographical Society of Manchester recently inspected Mr. Hyde's collections, which have taken nearly twenty years to bring together. The museum has been open to the public for seven months. The contents of the museum are systematically arranged in three rooms; the first containing corals, sponges, crabs, &c., the second is devoted to botany, and the third is furnished with fresh-water aquaria and ferns.

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SOME interesting antiquarian objects have been recently acquired by the Christiania Museum. They consist of relics of the middle iron age, found in two barrows at Larvik. Lances, a shield, silver buckles, and urns are included in this rich "find."

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THE trustees of the Australian Museum, Sydney, announce that they will be glad to receive exchanges in the group of Percoid Fishes with the authorities of other museums.

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THE Colombo Museum possesses a rich collection of moths, and the curator, Mr. Haly, has just published his "first report" upon the section, in which appear many facts of interest concerning the local distribution of the Indian moths and their times of appearance.

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MR. H. M. PLATNAUER, curator of the York Museum, would be glad if any naturalist would assist him with information upon the subject of Hybridism in the Animal Kingdom. He is in correspondence with a French naturalist who is interested in the subject.

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WARWICK MUSEUM.—The Rev. P. B. Brodie, F.G.S., Hon. Geol. Curator to the Warwick Nat. Hist. Society, has favoured us with some additional particulars of interest relative to this Museum:—In addition to a large and illustrative local collection of Lias fossils, one of the marked features of the geological contents in this Museum is the fine and unique series of Triassic fossils, the best in the kingdom, from the upper and lower divisions of the New Red Sandstone in the immediate neighbourhood of Warwick. These consist of the remains of labyrinthodon, caldyodon, hyperodapedon, mastodontosaurus, and diadetegonathus, including entire jaws with teeth, parts of the cranium, and other detached portions of the skeleton, more or less perfect. One fine head is nearly entire. These have been carefully examined and described by Professor Huxley and Professor Miall. As the quarries from whence these specimens were obtained are now closed, no more can be got at present. These were found in the Lower Keuper, chiefly at Warwick, near Leamington, and Cubbington. There is also a fine series of footprints of labyrinthodon, (the so-called cheirotherium) and rhynchosaurus; defensive spines and palatal teeth of *Acrodus kuperines* (Smith Woodward), two very rare fish, *Leptolepis superses* (Egerton), and *Semionotus brodici* (E. T. Newton), besides remains of boltzia fruits, &c., which, unfortunately, are always very badly preserved, from the Upper Keuper of Shrewley and Rowington, north-west of Warwick. All working geologists know very well how rare any fossils are in the English New Red Sandstone, and, when they are met with, how fragmentary and imperfect they generally are; therefore, such a collection as that in the Museum at Warwick is of great interest and value. Many scientific persons well able to judge have visited this Museum, and have invariably spoken in high commendation of its contents and arrangement.

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An exhibition of photographs has been opened in the Peel Park Museum and Art Gallery, Manchester, which has been lately enriched by a bequest from the late Mr. Tootal of a fine piece of sculpture called the Swan Maiden, by Schwanthaler. Some valuable additions have also been made to the Langworthy Gallery.

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An addition to the already fine collection of meteorites, which is under the care of Mr. Lazarus Fletcher, at the New Natural History Museum, Cromwell Road, South Kensington, has just been secured. It consists of a section of a meteoric mass which fell a couple of years ago in Oregon; the other portions remain the property of the Vienna Museum. The special feature of this meteorite is the large size of the crystals of olivine and other constituent minerals.

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The British Museum has also lately obtained a specimen of the *Fregilupus*, an exceedingly rare extinct bird of the island of Réunion. It belongs to the family of the starlings, and has yellow bills and legs, with a peculiar crest-like adornment. The bird is a rarity like the dodo or the great auk, for only about a dozen specimens are known to be in existence.

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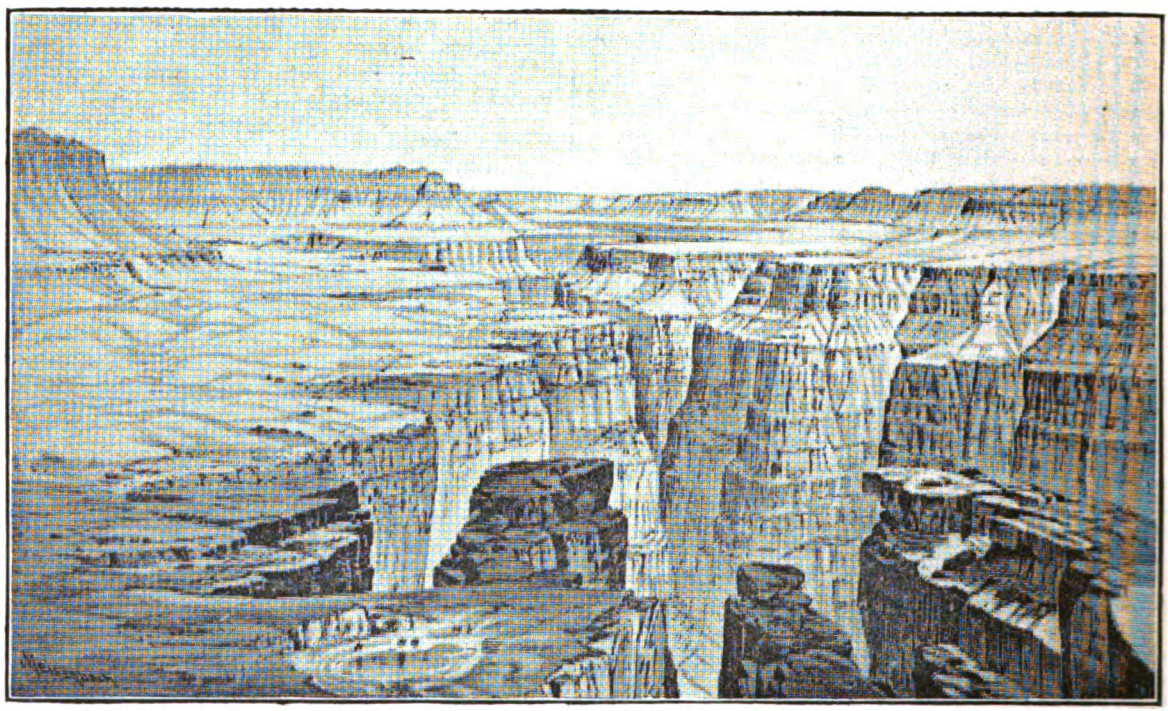

The Evolution of the Grand Cañon of the Colorado:

A Problem in Physiographical Geology.*

By W. Hewitt, B.Sc.

In the year 1882 there was published, in connection with the United States Geol. Survey, a monograph, excellently written and splendidly illustrated, entitled "Tertiary History of the Grand Cañon District," by Capt. C. E. Dutton, and the work was accompanied by an atlas of plates containing some magnificent panoramic views (by Mr. W. H. Holmes) of the unique scenery of this marvellous district. The problem which Capt. Dutton set himself to solve, and which he appears to have admirably succeeded in solving, viz., the history of the Grand Cañon of the Colorado River, is set forth in this volume, together with the conclusions at which he arrived, and the lines of argument along which he proceeded to those conclusions. The manner in which he expounds the facts upon which his arguments are based, the statement of the various converging lines of reasoning which he brings to bear in succession upon the problem, and the number of points of collateral interest which are suggested, render this monograph one of the best geological studies that I know. At the same time, the graceful literary style and the admirable illustrations render the task one of the most delightful that a geological student can set himself. The object of the present paper is to give in a concise form a sketch of the main problems in physiographical geology which Capt. Dutton had to investigate, and of the evidence and arguments upon which the solutions he offers are based.

The Colorado River is some 2,000 miles in length, receives the main part of its supply from the western slopes of the Rocky Mountain Range lying to the east of the province of Utah, and empties itself into the head of the Gulf of California. The Grand Cañon district with which we are concerned lies to the south of the High Plateaus of Utah, and may be described as a great Carboniferous platform, bounded on the north, and to some extent on the east, by a succession of terraced escarpments of Permian, Mesozoic, and lower Eocene formations, altogether from thirty to forty miles in breadth; while to the west it is cut off by a large fault from a region of Silurian and Archean rocks, which lie at a depth of from 3,000 to 4,500 feet at the foot of a wall produced by the displacement attending the fault. Through this district the Colorado River flows in a general W.S.W. direction, receiving as permanent tributaries only the Little Colorado and Cataract Creek on the south, and the Kanab Creek on the north. The gorge in which the river here runs is known as the Grand and Marble Cañons, the Marble Cañon being 66 miles long, and the Grand Cañon 218 miles long, whilst the depth varies from 200 or 300 feet at the head of the Marble Cañon to 6,000 feet at the deepest portion of the Grand Cañon. It really consists, however, of two distinct portions, an upper and wider gorge with walls over 2,000 feet high and five to ten or twelve miles apart, and in the esplanade between these walls an inner gorge cut to a depth

* A Paper read before the Liverpool Geological Association, June 3rd, 1889.

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of 3,000 feet or more, and with a width of 3,500 to 4,000 feet. The river itself has a width of from 250 to 450 feet.

The Grand Cañon district is composed of rocks which are remarkable for their general horizontality of arrangement, the uniformity of structure in horizontal range, the massive and conformable character of the beds, which, however, vary very considerably in character in vertical succession. The surface of the plateau is formed by one of the upper members of the Carboniferous series. On the north and east, around nearly two-thirds of its periphery, the Permian and Mesozoic rocks rise 5,000 feet in a series of gigantic steps to the High Plateaus. On the west the Carboniferous platform is suddenly cut off by a great fault, with a throw of 6,000 feet, which leaves a wild desert sierra district at more than half that depth below the platform. On the surface of the platform here and there are isolated patches of Permian rocks, which have apparently been preserved by reason of a capping of hard basalt; these are known as "buttes." Capt. Dutton justly argues from several considerations, *e.g.*, the abrupt endings of the beds in step-like cliffs along a great part of the boundary, the presence of the outliers, and the fact that the material of these sedimentary deposits was derived from the west, that the whole of this Carboniferous platform was formerly covered with a complete series of beds up to and including the lower Eocene (which caps the highest of the terraces); and to the removal of this vast mass of material, having a thickness of about 10,000 feet over an area of 13,000 to 15,000 square miles, he gives the name of "the great denudation." All this material has been carried down by the Colorado river into the Pacific Ocean, and of course since the time of the lower Eocene.

The rocks have a general slight dip of about 2° towards the north, and it is noticeable that in this district, as well as in the Terraces, the river flows against the dip, or, in other words, is altogether independent of the present configuration of the country. This, it is pointed out, shows clearly that the river is older than the present surface features. In Captain Dutton's words —"The great rivers of a country are, as a rule, born with the country itself, their courses were determined by the conditions prevailing at the time of their origin; their positions, once established, are (with certain qualifications) immutable. From these propositions flow consequences of great importance. Thus, when we find rivers flowing across or through mountain chains or plateaus, we must infer that they are older than the structural deformations which they traverse; that the elevation of a platform across the track of a river rarely diverts it from its course, for the stream saws its bed into the rocks as fast as the obstacle rises." The Colorado drained the great Eocene lake that existed to the north of this district, and since it began to flow the existing surface features, the displacements, the features, and the elevations have been produced; and the drainage system is intelligible only on the supposition of the extension of the Mesozoic beds over the whole district and the post-Eocene age of the displacements and elevations.

While the outer gorge is cut merely through the upper Carboniferous rocks, the inner gorge is sunk in many places through the whole of the Carboniferous beds to unconformable beds below, which, in some places, are Archean schists, in others probably of Silurian age.

The platform to the north of the Cañon is divided into five distinct plateaus, either by faults or monoclinal flexures running north and south. These flexures, it may be said, are considered by some western geologists as incipient faults, or, at all events, as in some way related to faults in their origin and signification.

The meteorological conditions of the district are important. In summer the heat is intense and the dryness of the air extreme; from June to September the mid-day temperature of the air is seldom below 90° F., and often exceeds 110° F. The rainfall, as a rule, is very small; what there is takes place chiefly in the winter months, and Captain Dutton states that as a consequence of the extreme dryness of the air many of the showers fail to reach the earth, being completely evaporated on their way. The result of these conditions is that scarcely any permanently flowing tributaries fall into the Colorado in this district, and these, like the main river itself, are fed from the precipitation on the high lands at a distance. That this was not always the case is shown by the numerous shallow river valleys scattered over the district, now, however, almost always dry; though, after the occasional heavy rains, they are occupied by torrents of liquid mud—the accumulation of the disintegrated material which has lain for want of transport. The greater part of the moisture precipitated on some of the higher parts of the district finds its way into the river by means of numerous springs, and this, as Captain Dutton points out, forms an important addition to the transporting power of the river without adding anything directly to the load to be carried. The scarcity of water supply forms one of the chief difficulties in the exploration of the region.

(To be continued.)

Vaccination and Small-Pox.

By E. Howarth.

THE small-pox epidemic which raged in Sheffield in 1887-8 assumed such a serious and important aspect that the Government sent Dr. Barry, one of the inspectors under the Local Government Board, to Sheffield, to inquire into the cause and history of the epidemic and the general conditions of the town. Dr. Barry commenced his inquiries in January, 1888, at a time when 300 new cases were occuring each week, and continued his observations uninterruptedly till June. In his report on the small-pox epidemic in Sheffield, recently presented to Parliament, Dr. Barry gives some very interesting information on the means adopted to prevent the spread of the disease: the statistics relating to vaccination being especially important and deserving of wide-spread circulation. Probably no such complete record of vaccination and small-pox in a large community was ever before obtained as was done in Sheffield at the time of the epidemic; for, in order to ascertain the extent to which the law of compulsory vaccination had been obeyed, a house to house visitation was made throughout the town by a largely-augmented staff of vaccination officers and assistants, and a very exact and complete record obtained, so that the relation of small-pox and vaccination could be very thoroughly traced. The total population (excluding the inmates of the workhouses), with regard to whom particulars as to small-pox and vaccination were obtained, was 274,112. Of this number 268,397, or 97·9 per cent., were stated to have been vaccinated, and 5,715, or 2·1 per cent, unvaccinated. Under ten years of age, the proportions were 96·8 vaccinated to 3·2 unvaccinated; and in persons aged ten years and upwards, the proportions were 98·3 vaccinated to 1·7 unvaccinated. In Sheffield the vaccination laws have evidently been tolerably well observed of late years, but this two per cent. of law-breakers, in a population of nearly 300,000, was sufficiently large to enable a comparison to be made of the liability to small-pox of vaccinated and unvaccinated persons.

Since 1871-2, when 1,007 persons died of small-pox in Sheffield, there has been comparatively few cases of the disease in the town until 1887-8, when it again extended into a severe epidemic. The first appearance of small-pox in 1887 was in March, and after that fresh cases occurred almost weekly, the number varying, but on the whole increasing, until they exceeded 100 a week in October, 200 a week in December, and reached 340 a week in January, 1888, after which they declined, and the number of fresh cases at the end of March was below 100, the disease finally dying out in August. From March 12, 1887, to March 31, 1888, the total number of small-pox cases was 6,088, of which 1,798 were treated in hospital and 4,290 in houses. The number of deaths from small-pox was 590, 260 of which occurred in hospital and 330 in houses. The small-pox attack per 1,000 of population was 19·3, and the death rate 1·86. The number of the vaccinated class of

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persons who died was 243, not 4·7 per cent , out of a total attacked of 4,995 ; and the deaths among unvaccinated was 320, or 31·1 per cent., out of a total of 1,028 (all fatal attacks occurring in unvaccinated children under one month of age excluded). The small-pox attack rate per cent. of estimated population was 1·62 for vaccinated persons, and 15·68 per cent. of unvaccinated ; while the death rate per cent. of estimated population was 0·08 for the vaccinated, and 4·88 for the unvaccinated. The effect of vaccination is more forcibly brought out in the fatality per cent. of attacks ; for, while the percentage of deaths among vaccinated was 4·7, it was 31·1 among the unvaccinated.

Of the children under ten years of age, living in Sheffield during 1887-8 under the common conditions of infection in the whole borough,

The attack rate per 1,000 of the vaccinated was 5
Do. do. of the unvaccinated 101
The death rate per 1,000 of the vaccinated ..... 0·09
Do. do. of the unvaccinated 44

(unvaccinated childen, aged under one month, are in every case excluded). That is to say, for 100,000 vaccinated children the rate of small-pox mortality gives nine deaths ; and for 100,000 unvaccinated children the rate of small pox mortality gives 4,400 deaths. Concerning persons over ten years of age—

The attack rate per 1,000 in persons twice vaccinated was... 3
Do. do. once vaccinated ... 19
Do. do. not vaccinated ... 94
The death rate among persons twice vaccinated was ..... 0·08
Do. do. once vaccinated 1
Do. do. not vaccinated 51

Therefore, for 100,000 persons over ten years old, and twice vaccinated, the rate of mortality would give eight deaths ; for the same number once vaccinated it would give 100 deaths ; and for the same number not vaccinated it would give 5,100 deaths.

The number of persons re-vaccinated in 1887-8 was 56,233, and of these only two were attacked by small-pox, and none died. 8,198 persons had been re-vaccinated prior to 1887-8, and of these 25 were attacked, and only one died. Of 18,292 persons who had suffered from small-pox prior to 1887-8, 25 were again attacked, and five died.

Dr. Barry's report contains a mass of detailed information of the highest importance, but space will not allow further extracts to be given here. A committee of the House of Commons has been appointed to consider this report and the question of vaccination generally, but the teaching of the above facts is so apparent that no committee is required to elucidate their meeting. One enthusiastic searcher after knowledge in Sheffield suggested that the Health Committee should furnish each householder with a copy of Dr. Barry's report, but as the cost of each copy is 24/-, and the number of householders over 70,000, that would be rather too large an order. It is evident that some of the inhabitants have failed to make themselves acquainted with the contents of the report, for on the 4th of May an anti-vaccination society was formed in Sheffield. There is one other point clearly demonstrated in the report that deserves mention, as it very nearly concerns those charged with caring for the health of large municipalities. The Borough hospital, in which small-pox cases were treated in Sheffield, is situated in a populous part of the borough, and there is no doubt that the hospital played an important part in spreading the disease. Dr. Barry illustrates by a series of charts the number of fresh cases every fortnight and their distribution in the borough, and these charts show in a most striking manner how the disease clustered round the hospital. Throughout nine months—June, 1887, to March, 1888—the houses within a 4,000 feet circle round the hospital had been invaded by small-pox to twice the extent, and the houses within the area of 2,000 feet circle had been invaded to three times the extent of houses situated elsewhere in the borough. The Town Council of Sheffield, during the course of the epidemic, wisely erected an hospital on the outskirts of the borough, far removed from the population, and there is no fear of small-pox cases ever again being treated in a hospital situated in a populous neighbourhood. This is a lesson other towns would do well to profit by.

Our Portrait Gallery.

XIII.—SIR J. WILLIAM DAWSON, C.M.G., M.A., LL.D., F.R.S., &c.

No one who appreciates the great value and importance of vast labours in the domain of Palæontology and Geology can think of a name more honourably distinguished than that of Sir J. W. Dawson, of Montreal. The services which he has rendered so readily for a considerable number of years to the cause of Palæontology, and his unwearied industry in this his favourite branch of science are remarkable. The study of Palæontology requires a peculiar training. In this department of knowledge it is absolutely indispensable that one should have a thorough acquaintance of allied subjects, such as Natural History and Physical Geography. His published writings are evidence of Sir J. W. Dawson's special fitness in this particular direction. In his peculiar qualifications he resembles that clever and genial palæontologist and geologist, the late Professor Edward Forbes, and it is interesting to note that Sir Charles Lyell remarked to Dr. Bigsby, on the death of Forbes, "Now I look chiefly to Dawson, of Montreal, for any true progress in the philosophy of geology."

He has fully justified the expectations of Lyell. In the wide field of Palæontology both the animal and vegetable creation is within range of investigation. Whilst many devote themselves to the one branch exclusively, and concentrate their energies on the animal remains found in a fossil state, others are drawn to the vegetable kingdom, and so the other branch, Palæo-Botany, has been worked. In this latter branch Sir J. W. Dawson has laboured most assiduously, and his works and papers are esteemed by the most successful fossil botanists of the day. There have been but few workers in this department, and the discoveries of Sir J. W. Dawson in this direction alone entitle him to rank as the most eminent fossil botanist of our own age. As the discoverer of the oldest known form of animal life (*Eozoön Canadense*) in the Laurentian limestones he is known throughout the civilised world, and his name in connection therewith must go down to posterity. Not alone is he in the foremost rank in Palæontology, but in Geology he has done most excellent work.

The following particulars concerning his life and work will probably have great attraction for our readers, and will afford some idea of the immense amount of work that can be accomplished by a clever and painstaking scientist.

Sir J. W. Dawson was born in October, 1820, at Pictou, in Nova Scotia. He went over to the University of Edinburgh, and there studied under some of the most

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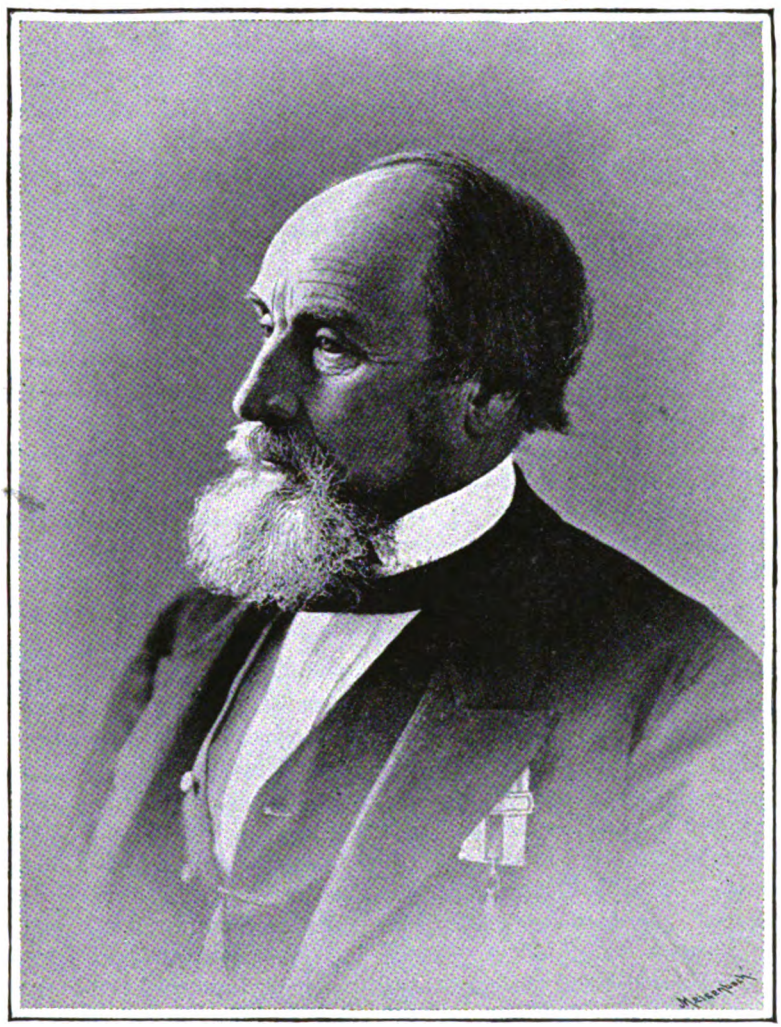

SIR WILLIAM DAWSON, C.M.G., M.A., LL.D., F.R.S., &c.

From a Photograph by Wm. Notman & Son, Montreal.

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renowned professors in natural science at that time. He had for his contemporaries many men of mark, who subsequently came to the front in educational matters. There is no question that his love for geology and kindred subjects was there stimulated and fostered. This is evident from his own words. "The foundation of my geological education was laid by the late Professor Jameson and other able educators in natural science, his contemporaries in Edinburgh." He returned home with an ardent love for scientific pursuits, and immediately started an investigation of the natural history and geology of Nova Scotia and New Brunswick. The results of these studies are to be found in his book entitled "Acadian Geology," the third edition of which was published in 1880. This is a most valuable publication, and no student of geology who desires to work in those particular provinces can afford to do without this book. It also throws a great deal of light on the physics of Arctic ice, as well as other matters affecting us here that makes the possession of the volume almost indispensable. Sir J. W. DAWSON acknowledges his indebtedness to Sir Charles Lyell, for he had the great advantage of his acquaintance, instruction, and advice. He thankfully refers to this connection when he says "the credit is due to the study of the 'Principles of Geology,' and to the personal friendship and generous kindness of Sir Charles Lyell, more than to any other cause." In 1842, and again ten years later, he accompanied Sir Charles Lyell in his explorations in Nova Scotia, assisting him greatly in his investigations. From the year 1843 he has been one of the most frequent contributors to the Proceedings of the Geological Society of London, and in 1881 Sir, then Mr., W.W. Smyth remarked that when he referred to his published papers he found that they numbered nearly 120, and they give the results of most extensive and valuable researches in various departments of geology, but more especially upon the Palæontology of the Devonian and Carboniferous formations of Northern America. No fewer than 30 of these have appeared in the pages of the *Quarterly Journal*. Not only have the pages of the Geological Society journal been enriched by his labours, but he has contributed articles from time to time to most of the scientific periodicals of the day. Whilst having the pen of a ready writer, and possessing the rare power of placing scientific subjects before the general reader in a most popular and engaging way, yet he is in no way hindered from accomplishing most abstruse and technical work. He is a well-known specialist, and has published many monographs on subjects relating to Palæontology. His works on the Erian Devonian and Carboniferous Floras of Eastern North America are published by the Geological Survey of Canada, and are invaluable to the student of fossil plants, and it is conceded that they are the most important contributions yet made to the palæozoic botany of North America.

Among the works from his pen not previously mentioned are the following:—"Archaia, or Studies on the Cosmogomy and Natural History of the Hebrew Scriptures," published in 1858. In 1872 he endeavoured to refute the Darwinian theory of the origin of species in the "Story of the Earth and Man." In 1875 "The Dawn of Life" appeared, wherein an account is given of the oldest known fossil remains, and he discusses their relations to geological time and the development of the animal kingdom. In 1877 he still combats Darwin in "The Origin of the World," and in 1878 "Fossil Men and their Modern Representatives" shows that he still maintains his ground. "The Chain of Life in Geological Time" appeared in 1880, and is a most instructive book. It sketches popularly the origin and succession of animals. His own country has not been forgotten. The pages of the *Canadian Naturalist*, and many American publications, have also been enriched by his prolific pen. His latest book is on the "Geographical Distribution of Plants," forming one of the International Series.

In 1850 he was appointed Superintendent of Education for Nova Scotia, and in 1855 he became principal of the McGill University at Montreal, of which seat of learning he is at present vice-chancellor. In 1881 he had the honour of receiving the Lyell medal of the Geological Society of London for eminent work and discoveries in Geology. This was especially gratifying to him; for, in a letter that he wrote in acknowledgment, he declares that he was most pleased that this token of kindly recognition was connected with the illustrious and honoured name of Sir Charles Lyell. In this year honours came thickly upon him. He was created a Companion of the Order of St. Michael and St. George, and then he had the felicity of being selected by the Governor-General of Canada, the Marquis of Lorne, to be the first President of the Royal Society of Canada, as also to take the Presidency of the American Association for the Advancement of Science. In 1884 he was granted the degree of LL.D. by his old university, and had also the further honour of being knighted by her Majesty. In 1886 he presided over the meeting of the British Association at Birmingham. His address on that occasion was a most interesting and striking one, and called forth high encomiums. Those who listened to Sir J. W. DAWSON's utterances on the Geographical History of the Atlantic Ocean will not soon forget them.

He is a Fellow of the Royal and Geological Societies of London, Honorary Fellow of the Geological Society of Edinburgh, and Honorary Member of the Philosophical Societies of Liverpool, Glasgow, Manchester, and Leeds. Last year the Liverpool Geological Association had the honour of having Sir J. W. DAWSON enrolled among its honorary members. In 1882 he attended the meeting of

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the British Association at Southport, afterwards proceeding on a tour through Egypt and Syria. This led to the publication of several papers, and a little work written in a popular manner, entitled "Egypt and Syria: their Geological and Physical Geography in Relation to Bible History." No one takes a kindlier interest in museums than Sir J. W. Dawson. He has, in fact, created the Peter Redpath Museum in Montreal, and no visitor to that city should go away without first seeing the splendid collection of fossil plants, the mineralogical specimens, and Dr. Carpenter's collection of shells. Most of the exhibits have been generously given by Sir J. W. Dawson, who leaves no stone unturned to enrich the museum, as any one entering it from time to time may easily testify. The museum at Liverpool exhibits signs of friendly visits from the subject of our sketch, and mementoes of his interest in the work here are to be seen in the stone gallery.

Thus Canada, the United States, and Great Britain are under a deep debt of gratitude to Sir J. W. Dawson for publications educational, scientific, and religious, and though the articles are multifarious they are all written in language lucid, eloquent, and easy to be understood.

All this has been accomplished, as Sir J. W. Dawson himself states, "in circumstances of isolation from the greater centres of scientific life, and under the pressure of the severe demand made in a new and growing country upon those engaged in educational persuits."

Sir J. W. Dawson has a world-wide reputation, and is held in great esteem both here and in his own country; and this article is written as a slight mark of the regard that we in England have for him, and also to show our high appreciation of his extensive and useful labours. S. G.

Notes in Brief.

The Yorkshire Boulder Committee, in pursuance of their work, have reported upon great numbers of hitherto unrecorded erratics from all parts of Yorkshire. The duties of the Committee would, however, be lightened if, in their determination of specimens of rocks sent in, they had a small collection of typical rocks to assist them in their decision. A circular has been issued inviting the co operation of geologists in this matter. If any of our readers can assist the Committee by forwarding to the Secretary, Mr. S. A. Adamson, F.G.S., 52, Wellclose Terrace, Leeds, any specimens, they will be rendering a good service to boulder investigation.

As a guide, it may be stated that the specimens of typical rocks should be collected from centres of glacial dispersion, or from districts which have been subjected to glacial action. They should not be weathered. A convenient size is 4in. × 3in. × 2in. They should be collected specially so as to obtain characteristic types, as cabinet specimens do not always secure complete authenticity.

The remains of a Roman potter's kiln have been uncovered during recent excavations at Hall Court Wood, near Winchester. The Royal Society of Antiquaries have taken cognisance of the discovery.

Active steps are being taken to establish a Pasteur Institute in London, and a meeting is announced for July 1st, at the Mansion House, in the furtherance of the scheme. The proposal has, however, met with some opposition.

A new method for treating rabies has been discovered by a physician at Vichy, Dr. Peyrand, which is said to be effectual. By injecting rabbits with the essence of the herb called "tansy" he produced a virus, with which was mingled 10 per cent. of chloral. The doctor claims to have been successful in curing four cases out of six by his method.

At a recent meeting of the Linnean Society, Mr. Thomas Christy, F.L.S., exhibited specimens of the Java upas-tree, the milk of which yields a poison. German doctors have lately discovered that the active principle of this poison (antiarine) contains a wonderful heart tonic.

For the first time the inland ice-cap of Greenland has been crossed from edge to edge. This has been achieved by the labours of Dr. Nansen, who recently related his experiences before the Danish Royal Geographical Society at Copenhagen.

Some interesting antiquarian discoveries have lately been made at Harborough Rocks, between Wirksworth and Brassington, where were found the remains of an ancient British village. A large quantity of vessels and pottery were found of various shapes, and decorated with the simplest ornamentations. A chambered barrow, containing about twenty human skeletons, was also found near the same spot.

In August will be opened a Photographic Convention for the United Kingdom, at St. James's Hall, Piccadilly, London, for which a very fine exhibition of photographs and apparatus is being arranged. A special part of the collection will be devoted to material illustrating historically the eras of photography, and there will also be space set apart for new inventions.

Dr. Pinel, of Paris, has been using the phonograph for purposes of hypnotic experiments. Several subjects were hypnotised by means of the phonograph, and as readily obeyed commands given through this channel as if made *vivâ voce*. These experiments support the conclusion, long since practically arrived at, that the real cause of the phenomena of hypnotism is nervous derangement on the part of the subjects. The old theory of a supposed personal magnetic current should now be quite discarded.

The physical apparatus of the late Dr. Warren de la Rue has been presented to the Royal Institution, where it will be preserved in the historical collection as commemorative of the important scientific work achieved by its late possessor.

Scientific students owe much to Free Libraries, and any method by which the advantages of these institutions may be extended is deserving of consideration. The June number of *The Library* contains a paper by Mr. Thomas Formby on "Donations to Free Libraries," which has some excellent suggestions bearing upon the subject.

Much discussion has arisen as to the real note of the cuckoo, which undergoes a well-marked change towards the end of the pairing season. From April to May the musical interval is invariably that of a major third, whilst in June it changes to a minor third. The former interval, it will be remembered, is that immortalised by Beethoven.

Two golden eagles were lately observed by a farmer at Stratherick, engaged in combat. One was secured, and has been housed in the London Zoological Gardens.

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DURING June heavy thunderstorms were recorded in many parts of the country. These will have given a fresh opportunity for procuring photographs of lightning flashes, of which some splendid examples have been exhibited before the Meteorological Society. The curious phenomena of a dark flash seen in the photograph accompanying the white flashes has been explained by Professor Stokes and Professor Curtis (of Harvard) to be the path of a vanished flash which has left a track of nitrous oxide gas behind it in the atmosphere, impervious to the light of the succeeding flash, and thus appearing opaque in the picture.

ANOTHER specimen of this bird (*Aquila Chrysaetos*) was seen by two ladies on the Quantock Hills, Somerset, to swoop down and carry off a small terrier dog, with which it flew away. To this same bird are ascribed various depredations which have occurred in the neighbourhood, such as the loss of lambs by local farmers.

THE widow of the late W. Cave Thomas, author of works on "Symmetrical Education" and "A Revised Theory of Light," has been granted a Civil List pension of £50 per annum.

THE United States Government are about to realise the idea of a national zoological park. A large extent of forest land near Washington is to be enclosed to provide a shelter for as complete a collection of animals as can be obtained.

IT is announced that some reindeer have been imported into Scotland from Norway. This is by no means the first attempt which has been made to acclimatise these animals in Britain. In the last century a Northumbrian peer tried the experiment in one of his parks.

A MEETING of the representatives of the provincial museums of the country was held at York, on 20th June, to consider a series of preliminary resolutions adopted at a provisional meeting last year. It was proposed to form an association of museum curators and representatives selected by the councils of management of such institutions. Other gentlemen engaged in scientific work would be admitted as associates. Professor W. H. Flower, President of the British Association, wrote expressing his sympathy with the movement. It was agreed that such an association be formed, and that the first annual meeting should take place in May or June, 1890, at Liverpool, under the presidency of the Rev. H. H. Higgins, M.A. Messrs. H. M. Platnauer (York) and T. J. Moore (Liverpool) were appointed secretaries. A portrait and biographical sketch of Mr. Higgins, the president of the association, appeared in our first number (July, 1888).

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between May 16th and June 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	Highest (June 5th)	30·47	Inches.
,, ,,	Lowest (May 28th)	29·51	,,
,, ,,	Mean	29·895	,,
,, ,,	,, for 22 years May	29·965	,,
,, ,,	,, ,, June	29·983	,,
Temperature	Highest (June 2nd)	74·0	Deg. F.
,,	Lowest (May 31st)	46·3	,,
,,	Mean	57·2	,,
,,	,, for 22 years May	51·6	,,
,,	,, ,, June	57·6	,,
,,	,, of Evaporation	52·8	,,
,,	,, ,, for 22 years May	47·7	,,
,,	,, ,, ,, June	53·5	,,
(*b*) Rainfall	Amount	1·790	Inches.
,, ,,	,, Mean for 22 years May	1·892	,,
,, ,,	,, ,, ,, June	1·903	,,
,,	Number of Days on which Rain fell	10	
,,	Greatest fall in 24 Hours (May 30th)	0·583	Inches.
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	6·3	
,,	,, ,, for 22 years May	6·2	
,,	,, ,, June	6·3	
(*c*) Wind	Velocity, Greatest (June 10th)	27	Miles.
,,	,, Least (May 16th)	1	,,
,,	,, Mean Hourly	9·9	,,
,,	Greatest Pressure on Square Foot (May 31, 4-20 p.m.)	16·6	Pounds.
,,	Direction at time of Greatest Pressure	SW	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
83	51	82	80	50	110	222	66	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

NOTE.—June 2nd, between 3 and 4 p.m. Violent thunderstorm, accompanied by heavy rain and hail. Three-tenths of an inch of rain fell in about five minutes. The hail stones which fell at Bidston, though of large size, were not of the abnormal description of some which are said to have fallen in the immediate neighbuorhood. During the storm the electric connections of the normal clock were partially destroyed.

Bolton.

The favourable weather of the first two weeks in May was continued through the third week, the barometer steadily rising, with calm or light airs, and mean temperature above the average. After four cloudy days, on the 18th a thunderstorm of moderate energy occurred, accompanied by lightning and followed by heavy rain. The weekly averages were :—Barometer 29·943 in. ; corrected mean temperature 55·07° ; humidity 75%. Totals :—Rainfall 0·674 in. on one day ; sunshine on 5 days 13 hours 39 minutes ; calm each day. From the 22nd to the 31st pressure was somewhat variable ; temperature on the 22nd and 23rd was very high, but gradually fell from 63° to 47·5° on the 28th ; on the 29th and 30th slight thunderstorms occurred. The averages for the ten days were :—Barometer 29·611 in. ; temperature 53·37° ; humidity 73% ; total rainfall 0·976 in. on six days ; sunshine on nine days 41 hours 46 minutes ; prevailing wind Easterly.

Taken altogether the month of May was more favourable to agriculture than for many years past. The mean barometric pressure (29·778 in.) was rather below the average, with very small range—0·56 in. Mean temperature, corrected for daily range, was 53·12°, against 42·7° in 1888, or 46·71 in 1887. No frosty nights occurred. The temperature of the soil at one and two feet deep, and of water with the bulb one foot below the surface of a large lake, averaged 3° higher than corresponding month last year ; humidity 76·6%. Rain fell on 16 days, well distributed in time, to a depth of 3·891 in., being 1·4 in. above the average. Bright sunshine was recorded on 24 days, but the total (95 hours) was considerably below the average.

During the first week in June the weather was bright, warm, and (except the 1st and 2nd) fine. On the 2nd Bolton had the severest thunderstorms experienced here for upwards of two years. Commencing soon after 7 a.m. with heavy rain, the thunder and lightning were loud and vivid for 2¼ hours, and again from 3-15 p.m. till 5. The electrical disturbance was severe over a very large area. No hail fell at the Observatory or on the Westerly side of the town, but on the Easterly side, at a distance of a mile to the N. E, and S. E. of the

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county, large hail stones are reported to have fallen. The average pressure was 30·054 in., range 0·86 in.; temperature 59·1°; humidity 76%; total rainfall 0·542 in.; sunshine 50 hours 6 minutes; wind variable light breezes. From the 8th to the 14th pressure was steadier, and averaged 29·897 in.; temperature 53·95°; humidity 71%; rain fell on the 8th and 14th to the extent of only 0·032 in.; more or less sunshine on each day, with a total of 27 hours 18 minutes; calm or N. Easterly breezes.

The following comparison of the accumulated amounts of rainfall, bright sunshine, and "growing" temperature from January 1st to June 14th for the last three years will show the remarkable contrast in favour of 1889, and explain the cause of the jolly faces of farmers:—

Accumulations of	1887.	1888.	1889.
Growing temperature	1157·8°	1081·4°	1418·7°
Rainfall	10·692 in.	11·461 in.	14·411 in.
Bright sunshine	484 hrs. 2 m.	373 hrs. 9 m.	393 hrs. 13 m.

From this table it will be seen that the rainfall (an average one) and the excess of temperature above that of growing point are about 40% more than they were in 1888; and probably the difference in weight of grass, &c., will bear quite as great an excess.

W. W. Midgley, F.R.Met.S.

Met. Observatory, Bolton, June 15, 1889.

Sheffield.

Meteorological Summary.

May, 1889.	Temperature. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for May.* Daily Max.	Daily Min.	Rainfall. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for May.* Ins.
Sheffield ...	76°	22d	40°	1st	56°	—	—	3·84	16	0·73	24th	—
Spurn Head.	65°	24th	41°	16th	51°	—	—	2 79	14	0·66	27th	—
York	78°	22d	41°	3rd	56°	59°	42°	3·66	15	1·50	10th	1·71
Barrow	71°	6th	42°	2nd	55°	—	—	3·83	17	0·75	5th	—
Liverpool ...	72°	22d	40°	2nd	55°	57°	45°	2·46	16	0·55	30th	1·74
Holyhead ..	65°	21st	41°	2nd	53°	56°	46	1·82	17	0·60	5th	1·88
Oxford	77°	23rd	41°	2nd	56°	60°	44	3·22	17	1·43	26th	1·83
London	82°	23rd	41°	2nd	57°	62°	44	3·63	15	0·90	25th	1·73

* The means of Temperature and Rainfall for May are for 15 years.

May 16 to June 15, 1889.

Pressure.

On May 16th atmospheric pressure was between 29·9 in. and 30·0 in. all over the kingdom, and it remained the same on the 17th but fell slightly on the 18th, changing but little on the 19th, but rising again on the 20th to 30·0 in., and on the 21st the barometer readings reached 30·1 in. all over England. On the 22nd the barometer was slowly falling, and continued to do so on the 23rd, when it ranged from 29·7 in. to 29·9 in., and on the 24th it was down to 29·5 in. in the N. W. and 29·6 in the S. E., remaining low on the 25th and 26th, though rising on the latter date. It changed but little on the 27th, but gave way on the 28th and 29th, when it was down to 29·4 in. in the S. W. Pressure was rather unsteady and irregular on the 30th, the readings being 29·4 in. in the S. W., 29·9 in. in the S. E., and 29·5 in. in the N. It increased slightly on the 31st but was still unsteady, and on the 1st of June it fell decidedly in the W., but had risen to 30·0 in the E. On June 2nd pressure became more regular and even, ranging from 29·6 in. to 29·9 in., and similar conditions prevailed on the 3rd, and afterwards the barometer steadily rose, reaching 30·0 in. on the 4th, and 30·4 in. on the 5th, and it remained above 30·0 in. till the 8th, though slowly giving way. On the 9th pressure had declined to 29·7 in. in the S. E and 29·9 in. in the W., but it improved slightly on the 10th, and from the 11th to the 15th it was tolerably even, being 29·9 in. in nearly all parts of England. So that throughout the month the barometer has at no time varied very greatly, though there have been several shallow depressions, and the distribution of pressure has been rather irregular.

The Weather.

From May 16th to 18th (three days) the weather was rather dull and foggy, but dry, and temperature varied considerably, the maximum readings being below 60° in most places, but exceeding 70° at York, London, and Oxford, and there was a severe thunderstorm at the latter place on the 17th. During the week ending May 25th the weather underwent considerable change. At the beginning of the week the weather was foggy and at times thick, and though temperature was low the air was "muggy." On the 22nd the sky became clearer and temperature rose, and for the next two days it exceeded 80° at London and inland over England. On the 24th rain and thunderstorms began to spread over the country and continued on the 25th, and there was a general fall in temperature. From the 16th to the 25th (ten days) rain fell on four days at Spurn and London, three at Sheffield, York, and Oxford, two at Barrow and Holyhead, and one at Liverpool. From May 26th to June 1st the weather was changeable and showery, and thunderstorms occurred daily, the rainfall being heavy, at Oxford and other places exceeding an inch. Temperature varied considerably, the maximum readings being below 60° on the 27th and 28th, and above 70° on June 1st. Rain fell on six days at Spurn, York, Barrow, Liverpool, and Oxford, and on five days at Sheffield, Holyhead, and London. During the week ending June 8th the weather underwent a decided change. On the 2nd it was showery with severe thunderstorms, accompanied by hail of remarkable size and peculiarly dense clouds. Some hail stones which fell in Liverpool during the thunderstorm on the 2nd measured from ⅞ to 1¾ in. in diameter, and took more than 1½ hours to melt while lying on the grass with temperature at 65° Fahr. On the 3rd there were thunderstorms in Scotland, but the weather had improved over England, and for the remainder of the week it was fine generally except in the South, where thunderstorms occurred on the 6th and 7th. Temperature was high, the maximum readings exceeding 80° in many places. Rain fell on three days at Spurn, Holyhead, and Oxford, two at York, Barrow, Liverpool, and London, and one at Sheffield. During the week ending June 15th there were some heavy local showers, and thunderstorms in the South, but in most places the weather was fair, though there was a good deal of fog, and temperature was low most of the time. There was rain on four days at London and Oxford, three at Barrow, Liverpool, and Holyhead, and one at Sheffield, Spurn, and York.

The Sun.

During the month the sun has been entirely from spots on those days when the weather allowed observations to be made.

E. Howarth, F.R.A.S.

Museum and Observatory, Sheffield, June 20, 1889.

Some Remarkable Forms of Hailstones

Which fell on Sunday, June 2nd, during a Thunderstorm.

By D. Clague, F.G.S.

Between three and four o'clock on the afternoon of Sunday, June 2nd, a heavy thunderstorm burst over Liverpool, during which hailstones of considerable size fell, to the manifest discomfort of horses and other animals, human included, which happened to be exposed to the storm.

The first stones which fell were of an irregular, angular shape, varying in size from half to three-quarters of an inch across. Subsequently larger lumps of ice fell; some of them were of great interest from their shape and construction as well as from their size.

After the storm a number were gathered in a garden in Smithdown Road, where, having fallen on the grass, they were less damaged than

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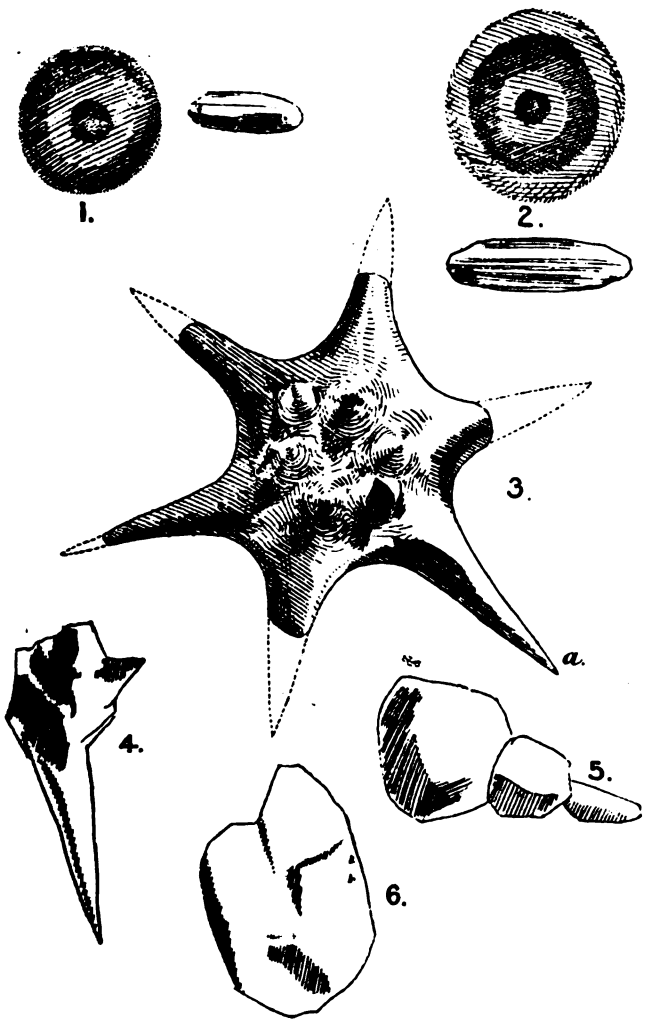
those which were broken by falling on the flagged roads, and, although much eroded and partially melted by the rain which fell after the hail-storm, sufficient of their original beauty was left to interest the observer. The accompanying sketches illustrate some of the forms.



Nos. 1 and 2 represent discoidal forms that were common. In thickness these varied from ⅛ to ¼ of an inch, and were from ½ to 1 inch in diameter, and were composed of alternate ranges of *clear blue* and *white opaque* ice. In some cases the clear blue was outside and in others the opaque ring was outside; in both cases the outer ring was equally hard, so correcting the theory that the opaque ring is composed of uncompressed snow.

No. 3 is a very remarkable form, which consisted of a solid case of ice 1¼-inch thick, surrounded by protrubrances which in (*a*) was terminated in a sharp point; the others had no doubt been originally as complete, but the points had either been broken in the fall or had melted. These spinal protrubrances were arranged so that sections taken across in four different directions would result in a six-rayed star appearance; altogether it reminded the observer of the spiked balls used by the South Sea Islanders as civilizers of their less fortunate neighbours.

No. 4 is manifestly a broken fragment of a form similar to No. 3.

No. 5 may be several irregular-shaped lumps of ice, congealed together when brought into contact after falling; but the more probable explanation is that it represents the stages of the growth of the ice-crystals, and shows that when freely suspended in air that the larger masses of ice obey the laws of crystallization as well as the smaller crystallites as seen in chemical solutions under the microscope.

No. 6. An irregular lump of ice 1¼ inch long and 5/6 of an inch broad, which is probably portion of the solid case of a form resembling No. 3.

Liverpool, June 12th, 1889.

More About the Wirral Runic Stone.*

By the Rev. W. Dallow.

It may not be out of place to state here that Runic characters, or Runes, are not a language, but a species of alphabet used by the old Gothic tribes of Northern Europe, and said to have been used for secrecy or divination. Rûn is Teutonic for mystery. In a good cyclopœdia the Runes are given in three parallel columns—the Norse, the German, and Anglo-Saxon—which all differ somewhat from one another. As masonic Pagan signs, used by the Scandinavian priests, they were tolerated by the Church, when she evangelized the nations; but after Christianity had become firmly rooted their use was discouraged, and in places forbidden under ecclesiastical censure, as at the council of Toledo.

The learned Dr. Stephens has thrown fresh light upon the Overchurch stone, though, owing to its being but a fragment, complete evidence is not forthcoming. The first sketch sent to him was taken carefully in pencil from the stone, but when photography came to our aid the Runes were more easily and more correctly deciphered. Thus, after the Professor had spent many hours examining with a powerful lens the two photographs sent to him, from one of which the clever illustration was produced in *Research* for June, he considerably altered his opinion. The inscription now stands as follows:—

F O L C W A R $\bar{A}$ R D O N B E C U N .....
I N W I D D E A TH F O T E A TH E A M U N .....

The small letters are the *probably* missing Runes (*vide* woodcut), and the pairs of letters coupled together represent each a *single* Rune. It is considered to be monument, or grave-stone, to some man Folcwar, who must have been a somewhat distinguished man in his age (7th century), as is evident from the size of the block, the inscription so carefully incised, and the elegant interlaced pattern carved on the upper side. Supposing the slab, when entire, to have been about the length of a man, only a third of the epitaph is left. That there was not a *third* line below these two is quite clear from the state of the stone, which shows no mark of a chisel (*vide* woodcut). The interpretation is supposed to run thus:—

F O L C W A R = Anglo-Saxon proper name.

A R D O N = A R O D O N = honoured. Perfect 3rd plural, from verb *arian*.

B E C U N = monument, or tombstone.

N.B.—Dr. Stephens is of opinion that here followed the names of those who thus "honoured Folcwar."

As to the second line, the small marks on the stone warrant the first word being—

I N W I D = guile, deceit, or cruelty.

D E A TH F O T E = death-struck (death-footed!). The Saxon adjective, "death-faege" = death-doomed.

A TH E = oath.

A M U N = Saxon, amunan = to think of, to call to mind.

The whole inscription being so fragmentary, we can merely guess from the second line that the unhappy man came by a violent death of some kind; but as to who this Folcwar was, and whether Christian or Pagan, there seems but little hope of discovering.

* See *Research*, vol. i, page 225.

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The stone is supposed to have belonged to no sacred edifice, being of 7th or 8th century; for the church of Overchurch was not built for ages after. Where, then, did this Runic stone come from, when it was inadvertently built into the church by the careless Normans, and its inscription thus hidden until our own day? The Wirral was at that time but sparsely populated, and wild forest-land until the reign of Edward III.

A last word about the old temple of Overchurch, re-built in 1813, and pulled down and cleared away in 1887. While the chief stones were purchased by the gentleman before alluded to others were built into the churchyard, and others again, showing architectural cutting and Norman tooling, now adorn the walls of a neighbouring *farm-yard!!* Thus, in the words of Jeremias (*Lament.* iv.), "the stones of the sanctuary are scattered," wherein once worshipped the old catholic families of the Orrebies, the Ardernes, and many generations of Bold.

NOTE.—Since writing the above a letter has arrived from the Rev. G. Browne, B.D., the Disney Professor of Archæology at Cambridge, who has kindly taken much trouble over the above Runic inscription. He makes the first line run thus:—

F O L C = folks, people (W?).
A R A R D O N = reared.
B E C U N = monument (literally beacon) or tomb to some person, &c.

Reviews.

The International Annual of Anthony's Photographic Bulletin.

[London: Illiffe and Son, June, 1888.]

THIS forms the supplementary annual volume of a well-known American publication, and will be welcomed by the photographic fraternity on this side of the ocean. It contains a complete list of British, Colonial, and American photographic societies, together with some excellent and practical papers bearing upon the art of photography. It is embellished with a fine portrait study by Falk, and sundry other pictures by various processes of reproduction.

The Periodical Press Index (London: Trubner & Co.) is the title of a new monthly publication of a decidedly novel character, so far as this country is concerned. It aims at providing a monthly record of the leading subjects mentioned in current literature, and gives in a form easy for reference, and indexed according to the subject-matter, a synopsis of the contents of the monthly and weekly periodicals. If this plan is sufficiently extended, the *Index* will prove a real boon to all literary or scientific workers. An annual summary will be published to save reference to each monthly part.

The Rhætics of Leicestershire. By H. E. Quilter.

THIS pamphlet forms a paper read before the Leicester Literary and Philosophical Society, and contains some added "Notes on Remains of Fossil Fishes from the Rhætic of Leicestershire," by A. Smith Woodward, F.G.S. These were obtained from the "bone-bed" of the Spinney Hill sections of these rocks and the shales of the South Wigston section. The author summarises our present knowledge of this formation, and includes the results of some recent investigations.

Annual Report of the Lancashire and Cheshire Entomological Society, 1888.

THE Secretary's report shows that eight meetings have been held, and some interesting papers read and specimens exhibited. Mr. S. J. Capper, the President, in his annual address reviews the work done by members of the Society, and refers to the unusual abundance of the madder-hawk moth, which he ascribes to their having been "blown over" from the Continent. Referring to the theory that the pupæ had lain dormant in the sand hills until proper atmospheric conditions obtained for their development, he says that "it requires a great amount of credulity to think they could do so for eighteen years."

Transactions of the Manchester Geological Society.

[Parts V., VI., VII. and VIII., 1889.]

THE proceedings of this Society are principally devoted to practical questions relating to mining, but questions on general geology and palæontology also come to the front. In the numbers of their *Transactions* now before us, some admirable papers will be found of the highest value to the geological student. Amongst them may be mentioned:—"The Volcanic Phenomena of Mull," by P. F. Kendall, M.A.; "The Salt Works at Hale, Lancashire;" "On a Large Boulder found in Oxford Street, Manchester," by P. F. Kendall; "The Effects of Roburite Fumes," by Henry Bramall; "On the Use of Roburite and Other Explosives in Mines," by W. Watts, F.G.S.; "Fish Remains from the Lower Coal Measures," by Herbert Bolton. Mr. Thomas Oldham also contributes an essay on the "Cause of Earthquakes, of the Dislocation and Overlapping of Strata, and of Similar Phenomena," all of which are ascribed to "centrifugal force," in a way which would seem to imply that the author's knowledge of elementary principles of physics or of geology needs strengthening somewhat before he should again launch out into discussion of theoretical questions. Mr. Bramall's paper on "The Effects of Roburite" was rendered additionally valuable from the testimony of Dr. J. J. Berry, who examined some of the men who had been using roburite, and described the symptoms of carbonic oxide poisoning noticed amongst these patients. Mr. Bramall stated that roburite should only be used where there is good ventilation, and the men should on no account be allowed to breathe the fumes.

Journal of the Liverpool Astronomical Society, April, 1889.

THIS journal (which is edited by Mr. J. H. Isaacs) continues to keep up to its standard. The following papers appear in this number:—"The Milky Way and the Visible Universe," by J. E. Gore, F.R.A.S.; "Why has our Moon no Polar Caps?" by S. J. Peal; "Lunar Occultations," by Jas. Reside; "Occultations of Jupiter, on 7th August, 1889," by J. Gill, and "Observations of the Aurora Borealis at Kirkwall," by J. W. Fleming.

The Naturalist (Leeds) and the *Wesley Naturalist* (London) are both doing good service in spreading abroad a more enlightened view of science amongst the people. The June number of the former journal contains some excellent matter, amongst which may be mentioned "Notes on the Botany of Derbyshire," by the Rev. W. H. Painter, and "At the Foot of the Wolds," by S. A. Adamson, F.G.S. The journal of the Wesley Scientific Society is quite abreast with the times in the information it affords. The Rev. H. Friend contributes to the June issue a paper on the "Life History of *Lophyrus Pini*," and Mr. H. E. Quilter one on "Ammonites."

Our Celebrities. Edited by Luis Engel.

[London: Swan, Sonnenschein & Co.]

THIS monthly publication contains three excellently-printed photographs by the permanent process, with biographical memoir. The number for May is remarkable for its fine portrait of Professor Huxley, which is intensely characteristic. The Professor also contributes himself an autobiographical sketch, in which the principal events of his life are touched upon in an exceedingly pleasant vein.

A Handbook of Cryptogamic Botany. By Alfred W. Bennett, M.A., B.Sc., F.L.S., and George Murray, F.L.S.

[London: Longmans and Co.]

To every student of vegetable histology and physiology the department of cryptogamic botany must ever be one of profound interest and fascination, and, with the *Handbook of Cryptogamic Botany* in his possession, the student will feel at every step that he has an invaluable guide. The authors, both of whom are well-known workers in this branch of biology, have worked long and labouriously to produce this work. Their aim has been, as we are told in the introduction, "to bring before the reader the main facts of structure, of development, and life history which mark the larger groups, contrasting them with one another, and referring only to the broader lines of demarcation within the groups." This object has been fairly successful, and, in saying this, we are not grudgingly or niggardly bestowing praise, for the subject is vast, and to bring within the compass of one handy volume of some 456 pages matter which is at once

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helpful to the beginner and at the same time much to meet the wants of the advanced student, is certainly no mean success. That the advanced student will find some disappointment we have no doubt, particularly so when he comes to refer to some of the subdivisions of the *Protophyta*; but here, as also in all the divisions of the book, compensation will be found in the form of references to an ample literature on the subjects. The book treats of the subject of Cryptogamic Botany under seven subdivisions, namely, the *Vascular cryptogams*, *muscineæ*, *characeæ*, *algæ*, *fungi*, *mycetozoa*, and *protophyta*. The authors have preferred to follow the descending scale in the treatment of the groups; this, as they profess in the introduction to the general student, "from the known to the unknown," is a very sound principle to go upon. Over this we are little disposed to contend, especially as the authors concur in the view that "in the laboratory" there is much to be said in favour of proceeding from the simple to the more complicated. But we scarcely realise the logic of quoting from the latest edition of Huxley and Martin's *Elementary Biology* in support of this view when we remember that this book is especially designed for the laboratory; and the change to the descending scale adopted in the last edition of *Elementary Biology*, we are of opinion is prejudicial to the success of a large class of students. Terminology has always been a sore point amongst specialists, and no doubt the authors of this work have laid themselves open to much question by some minds in the liberty they have taken in this direction. As they justly remark, "the first requisite in terminology after accuracy is simplicity, and to this end we have wherever possible used *Anglicised* instead of Latin and Greek forms." Hence we find the forms *sporange*, *archegone*, *antherid*, *calypter*, and *protoneme* for sporangium, archegonium, antheridium, calyptra, and protonema, and numerous others, which, to say the least, must become somewhat awkward to the student of morphology who has already become familiar with the classical forms. The authors revert to the former use of "spore," and in this signification give numerous examples of its force in compound terms. And in *macrospore* and *microspore* they restore the forms megaspore and microspore with the compounds megasporange and microsporange. In short, the tendency is to restrict the terminology and to be conservative; they wish "to base a system of terminology on *facts* which can be confirmed by actual observation, rather than on unproved hypotheses."

The work is well printed in clear type and on good paper. The illustrations include nearly four hundred, many of which are original; but we think the time has come when a larger number of *new* illustrations should appear in such works. We can hopefully recommend this new book to the notice of all modern students of cryptogamic botany, placing, as it does, in an attractive and trustworthy fashion the chief facts of this really fascinating field of study within reasonable compass.

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Quarterly Journal of the Geological Society.
[No. 178. May, 1889.]

STUDENTS of vulcanology will be especially interested in this number of the Geological Society's *Journal*, for it not only contains Professor J. W. Judd's valuable paper on "The Growth of Crysta's in Igneous Rocks after their Consolidation," in which he discusses the mode of origin of the characteristic structure of the "granophyric" eruptive rocks, but also gives the text of Professor Judd's much-talked-of researches on "The Tertiary Volcanoes of the Western Isles of Scotland," a subject which has lately aroused a considerable amount of acute controversy. The professor states, in the introduction to his paper, that his work in Scotland originally involved five years of heavy labour, much of which was done as a pioneer, for no reliable maps then existed upon which the observations of the geologist could be carefully recorded. During the last fifteen years he has been occupied with filling in the sketch previously drawn in outline. After reviewing the various opinions which were maintained previously to 1874, he details the conclusions which have been confirmed by subsequent observations, followed by a summary of those points disputed in Dr. Geikie's recent memoir. A large portion of the paper is devoted to the discussion of the "alternative theory of fissure-eruptions," in which Dr. Geikie's conclusions are criticised. "The hypothesis of 'fissure-eruption' appears to me now as it has always done," says Professor Judd, "as unnecessary as it is vague," and he points out that it is very difficult to understand what idea the advocates of this hypothesis wish to convey by their favourite phrase. This difficulty is not lessened by Dr. Geikie's explanatory remarks by way of discussion on the professor's paper, as he now states (contrary to the position he is understood to have formerly taken up) that the lavas did not flow out directly from long open fissures, "but that vents were established on such fissures sometimes of considerable size, with the usual accompaniments of volcanic eruptions." The president's anniversary address is also given in this part, and amongst other contents may be mentioned Dr. James Croll's paper on the "Evidence we Ought to Expect of Former Glacial Periods," and the Rev. R. Baron's brief account of the Geology of Madagascar.

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Liverpool Field Naturalists at Ingleton.

INGLETON, in the "land of caves and waterfalls," was the place selected for a field meeting of the Liverpool Naturalists' Field Club, on the 5th of June. The very name "Ingleton" is suggestive of "happy hunting grounds" for the naturalist among the limestone hills, and by the rocky streams of that most delightful neighbourhood. The hopes of the botanists were not disappointed, for the gloriously fine day was spent amongst many rare plants well worth recording. At Hellifield the party of members and friends, numbering 60, divided, 13 going to Ribblehead with the intention of visiting Weathercote Cave and ascending Ingleborough Scar, the remainder preferring to go on to Ingleton to botanise along the banks of the two rivers, the Doe and the Greta, which form the "falls" for which Ingleton is so famous.

The smaller section, after leaving the station at Ribblehead, proceeded along the road to Weathercote, passing between Whernside (2,414 feet) on the right and Ingleborough (2,373 feet) on the left. About half an hour's walk brought the party to Weathercote, which is a cavern over 100 feet deep and descended by means of rocky steps. Into this cave falls the river Doe, forming a fine cascade of about 80 feet, and then disappearing by a subterranean passage to reappear three-quarters of a mile lower down the valley. In this shady enclosure, *Saxifraga umbrosa*, wild London pride, flourished in abundance, rearing its delicate pink blossoms in the cool air. Along the road from Ribblehead another of these pretty plants was noticed, *Saxifraga hypnoides*, mossy saxifrage, taking its name from the resemblance of its tufted masses of finely-cut leaves to moss. The saxifrages are mostly rock-loving plants, and the name is derived from Latin "*saxum*," a rock, and "*frango*," I break, the roots of the plants being supposed to break the rocks on which they grow by pushing their way among the crevices. The flowers of *S. hypnoides* are fairly large and cream-coloured; the whole plant has an elegant growth.

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The stone is supposed to have belonged to no sacred edifice, being of 7th or 8th century; for the church of Overchurch was not built for ages after. Where, then, did this Runic stone come from, when it was inadvertently built into the church by the careless Normans, and its inscription thus hidden until our own day? The Wirral was at that time but sparsely populated, and wild forest-land until the reign of Edward III.

A last word about the old temple of Overchurch, re-built in 1813, and pulled down and cleared away in 1887. While the chief stones were purchased by the gentleman before alluded to others were built into the churchyard, and others again, showing architectural cutting and Norman tooling, now adorn the walls of a neighbouring *farm-yard!!* Thus, in the words of Jeremias (*Lament.* iv.), "the stones of the sanctuary are scattered," wherein once worshipped the old catholic families of the Orrebies, the Ardernes, and many generations of Bold-.

NOTE.—Since writing the above a letter has arrived from the Rev. G. Browne, B.D., the Disney Professor of Archæology at Cambridge, who has kindly taken much trouble over the above Runic inscription. He makes the first line run thus:—

F O L C = folks, people (W?).
A R A R D O N = reared.
B E C U N = monument (literally beacon) or tomb to some person, &c.

Reviews.

The International Annual of Anthony's Photographic Bulletin.

[London: Illiffe and Son, June, 1888.]

THIS forms the supplementary annual volume of a well-known American publication, and will be welcomed by the photographic fraternity on this side of the ocean. It contains a complete list of British, Colonial, and American photographic societies, together with some excellent and practical papers bearing upon the art of photography. It is embellished with a fine portrait study by Falk, and sundry other pictures by various processes of reproduction.

The Periodical Press Index (London: Trubner & Co.) is the title of a new monthly publication of a decidedly novel character, so far as this country is concerned. It aims at providing a monthly record of the leading subjects mentioned in current literature, and gives in a form easy for reference, and indexed according to the subject-matter, a synopsis of the contents of the monthly and weekly periodicals. If this plan is sufficiently extended, the *Index* will prove a real boon to all literary or scientific workers. An annual summary will be published to save reference to each monthly part.

The Rhætics of Leicestershire. By H. E. Quilter.

THIS pamphlet forms a paper read before the Leicester Literary and Philosophical Society, and contains some added "Notes on Remains of Fossil Fishes from the Rhætic of Leicestershire," by A. Smith Woodward, F.G.S. These were obtained from the "bone-bed" of the Spinney Hill sections of these rocks and the shales of the South Wigston section. The author summarises our present knowledge of this formation, and includes the results of some recent investigations.

Annual Report of the Lancashire and Cheshire Entomological Society, 1888.

THE Secretary's report shows that eight meetings have been held, and some interesting papers read and specimens exhibited. Mr. S. J. Capper, the President, in his annual address reviews the work done by members of the Society, and refers to the unusual abundance of the madder-hawk moth, which he ascribes to their having been "blown over" from the Continent. Referring to the theory that the pupæ had lain dormant in the sand hills until proper atmospheric conditions obtained for their development, he says that "it requires a great amount of credulity to think they could do so for eighteen years."

Transactions of the Manchester Geological Society.

[Parts V., VI., VII. and VIII., 1889.]

THE proceedings of this Society are principally devoted to practical questions relating to mining, but questions on general geology and palæontology also come to the front. In the numbers of their *Transactions* now before us, some admirable papers will be found of the highest value to the geological student. Amongst them may be mentioned:—"The Volcanic Phenomena of Mull," by P. F. Kendall, M.A.; "The Salt Works at Hale, Lancashire;" "On a Large Boulder found in Oxford Street, Manchester," by P. F. Kendall; "The Effects of Roburite Fumes," by Henry Bramall; "On the Use of Roburite and Other Explosives in Mines," by W. Watts, F.G.S.; "Fish Remains from the Lower Coal Measures," by Herbert Bolton. Mr. Thomas Oldham also contributes an essay on the "Cause of Earthquakes, of the Dislocation and Overlapping of Strata, and of Similar Phenomena," all of which are ascribed to "centrifugal force," in a way which would seem to imply that the author's knowledge of elementary principles of physics or of geology needs strengthening somewhat before he should again launch out into discussion of theoretical questions. Mr. Bramall's paper on "The Effects of Roburite" was rendered additionally valuable from the testimony of Dr. J. J. Berry, who examined some of the men who had been using roburite, and described the symptoms of carbonic oxide poisoning noticed amongst these patients. Mr. Bramall stated that roburite should only be used where there is good ventilation, and the men should on no account be allowed to breathe the fumes.

Journal of the Liverpool Astronomical Society, April, 1889.

THIS journal (which is edited by Mr. J. H. Isaacs) continues to keep up to its standard. The following papers appear in this number:—"The Milky Way and the Visible Universe," by J. E. Gore, F.R.A.S.; "Why has our Moon no Polar Caps?" by S. J. Peal; "Lunar Occultations," by Jas. Reside; "Occultations of Jupiter, on 7th August, 1889," by J. Gill, and "Observations of the Aurora Borealis at Kirkwall," by J. W. Fleming.

The Naturalist (Leeds) and the *Wesley Naturalist* (London) are both doing good service in spreading abroad a more enlightened view of science amongst the people. The June number of the former journal contains some excellent matter, amongst which may be mentioned "Notes on the Botany of Derbyshire," by the Rev. W. H. Painter, and "At the Foot of the Wolds," by S. A. Adamson, F.G.S. The journal of the Wesley Scientific Society is quite abreast with the times in the information it affords. The Rev. H. Friend contributes to the June issue a paper on the "Life History of *Lophyrus Pini*," and Mr. H. E. Quilter one on "Ammonites."

Our Celebrities. Edited by Luis Engel.

[London: Swan, Sonnenschein & Co.]

THIS monthly publication contains three excellently-printed photographs by the permanent process, with biographical memoir. The number for May is remarkable for its fine portrait of Professor Huxley, which is intensely characteristic. The Professor also contributes himself an autobiographical sketch, in which the principal events of his life are touched upon in an exceedingly pleasant vein.

A Handbook of Cryptogamic Botany. By Alfred W. Bennett, M.A., B.Sc., F.L.S., and George Murray, F.L.S.

[London: Longmans and Co.]

TO every student of vegetable histology and physiology the department of cryptogamic botany must ever be one of profound interest and fascination, and, with the *Handbook of Cryptogamic Botany* in his possession, the student will feel at every step that he has an invaluable guide. The authors, both of whom are well-known workers in this branch of biology, have worked long and laboriously to produce this work. Their aim has been, as we are told in the introduction, "to bring before the reader the main facts of structure, of development, and life history which mark the larger groups, contrasting them with one another, and referring only to the broader lines of demarcation within the groups." This object has been fairly successful, and, in saying this, we are not grudgingly or niggardly bestowing praise, for the subject is vast, and to bring within the compass of one handy volume of some 456 pages matter which is at once

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helpful to the beginner and at the same time much to meet the wants of the advanced student, is certainly no mean success. That the advanced student will find some disappointment we have no doubt, particularly so when he comes to refer to some of the subdivisions of the *Protophyta*; but here, as also in all the divisions of the book, compensation will be found in the form of references to an ample literature on the subjects. The book treats of the subject of Cryptogamic Botany under seven subdivisions, namely, the *Vascular cryptogams*, *muscineæ*, *characeæ*, *algæ*, *fungi*, *mycetozoa*, and *protophyta*. The authors have preferred to follow the descending scale in the treatment of the groups; this, as they profess in the introduction to the general student, "from the known to the unknown," is a very sound principle to go upon. Over this we are little disposed to contend, especially as the authors concur in the view that "in the laboratory" there is much to be said in favour of proceeding from the simple to the more complicated. But we scarcely realise the logic of quoting from the latest edition of Huxley and Martin's *Elementary Biology* in support of this view when we remember that this book is especially designed for the laboratory; and the change to the descending scale adopted in the last edition of *Elementary Biology*, we are of opinion is prejudicial to the success of a large class of students. Terminology has always been a sore point amongst specialists, and no doubt the authors of this work have laid themselves open to much question by some minds in the liberty they have taken in this direction. As they justly remark, "the first requisite in terminology after accuracy is simplicity, and to this end we have wherever possible used *Anglicised* instead of Latin and Greek forms." Hence we find the forms *sporange*, *archegone*, *antherid*, *calypter*, and *protoneme* for sporangium, archegonium, antheridium, calyptra, and protonema, and numerous others, which, to say the least, must become somewhat awkward to the student of morphology who has already become familiar with the classical forms. The authors revert to the former use of "spore," and in this signification give numerous examples of its force in compound terms. And in *macrospore* and *microspore* they restore the forms megaspore and microspore with the compounds megasporange and microsporange. In short, the tendency is to restrict the terminology and to be conservative; they wish "to base a system of terminology on *facts* which can be confirmed by actual observation, rather than on unproved hypotheses."

The work is well printed in clear type and on good paper. The illustrations include nearly four hundred, many of which are original; but we think the time has come when a larger number of *new* illustrations should appear in such works. We can hopefully recommend this new book to the notice of all modern students of cryptogamic botany, placing, as it does, in an attractive and trustworthy fashion the chief facts of this really fascinating field of study within reasonable compass.

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Quarterly Journal of the Geological Society.

[No. 178. May, 1889.]

STUDENTS of vulcanology will be especially interested in this number of the Geological Society's *Journal*, for it not only contains Professor J. W. Judd's valuable paper on "The Growth of Crysta's in Igneous Rocks after their Consolidation," in which he discusses the mode of origin of the characteristic structure of the "granophyric" eruptive rocks, but also gives the text of Professor Judd's much-talked-of researches on "The Tertiary Volcanoes of the Western Isles of Scotland," a subject which has lately aroused a considerable amount of acute controversy. The professor states, in the introduction to his paper, that his work in Scotland originally involved five years of heavy labour, much of which was done as a pioneer, for no reliable maps then existed upon which the observations of the geologist could be carefully recorded. During the last fifteen years he has been occupied with filling in the sketch previously drawn in outline. After reviewing the various opinions which were maintained previously to 1874, he details the conclusions which have been confirmed by subsequent observations, followed by a summary of those points disputed in Dr. Geikie's recent memoir. A large portion of the paper is devoted to the discussion of the "alternative theory of fissure-eruptions," in which Dr. Geikie's conclusions are criticised. "The hypothesis of 'fissure-eruption' appears to me now as it has always done," says Professor Judd, "as unnecessary as it is vague," and he points out that it is very difficult to understand what idea the advocates of this hypothesis wish to convey by their favourite phrase. This difficulty is not lessened by Dr. Geikie's explanatory remarks by way of discussion on the professor's paper, as he now states (contrary to the position he is understood to have formerly taken up) that the lavas did not flow out directly from long open fissures, "but that vents were established on such fissures sometimes of considerable size, with the usual accompaniments of volcanic eruptions." The president's anniversary address is also given in this part, and amongst other contents may be mentioned Dr. James Croll's paper on the "Evidence we Ought to Expect of Former Glacial Periods," and the Rev. R. Baron's brief account of the Geology of Madagascar.

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Liverpool Field Naturalists at Ingleton.

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like "elder" leaves, indeed the name "actœa" being derived from Greek "acté," the elder. The whole plant has a rank, unpleasant smell, and the small black berries are said to be poisonous; the flowers are rather insignificant and white.

Of the geraniums, the three following were most noticeable:—*G. pratense, G. sanguineum, and G. lucidum.* The fields in the valley were quite purple with the bright blossoms of *G. pratense*, blue meadow crane's bill, and a few good specimens of *G. sanguineum*, blood crane's bill, were gathered on the slopes; while *G. lucidum*, shining crane's bill, spread its shining leaves and red stems over the rocks everywhere.

Another very pretty plant was *Rubus chamæmorus*, or cloudberry; this was higher up the mountain, among the thick heather and the cotton grass *(Eriophorum vaginatum)*. It is one of the rose tribe, and nearly allied to the common blackberry. The whole plant does not exceed eight inches in height; the stem is simple, without thorns, and bearing two or three simple lobed leaves The delicate white flower is terminal, and the berry is orange in colour. Here, too, on the heathy parts, *Sedum villosum* was found. This little plant has very fleshy leaves which are tinged with red, and dull pinkish flowers, and, though not a striking-looking plant, was a good addition to the spoils of the day. Close by was the beautiful *Primula farinosa*, wild auricula, or mealy primrose. Its heads of bright lilac flowers and tufted leaves, covered underneath with a white mealy substance, easily distinguishes it from others of the order. The most noticeable of the umbelliferœ was *Myrrhis odorata*, or sweet cicely, gathered near Weathercote. This is a large, bushy plant with finely-cut leaves, the whole plant having a strong smell of aniseed, which is thought by some people to be most agreeable.

Another plant, which made its home on the first slope, was *Habenaria viridis*, frog orchis, a small, green orchis, with somewhat the growth of the "man orchis," but much smaller; with *H. viridis*, one specimen of *Habenaria albida*, small, white orchis, was found, a slender orchis with sweet-scented, small, cream-coloured flowers in a spike. *Orchis mascula*, early purple orchis, was in abundance. *Pinguicula vulgaris*, common butterwort, grew on the sloping banks, with its flat tufts of greasy, yellow-green leaves and violet-like flowers. *Hypocharis maculata*, spotted cat's ear, of the composite order, was in the same locality. It has ovate root-leaves of a dull green spotted with purple, the undersides being also purple. There are long hairs on the edges of the leaves, and the flowers are rather dingy yellow.

Near where the *Primula farinosa* grew was the little mountain everlasting, *Antennaria dioica*, having crisp, white flowers in a terminal cluster and tufts of silvery-green leaves. This is also one of the compositœ. Among the other plants, *Asperula odorata*, sweet woodruff, sweet as new-mown hay, raised its stiff whorls of bright green leaves, and its white starry flowers brightening the rough grass and herbage around. The pretty *Geum rivale* was plentiful, also *Valeriana dioica, Lysimachia nemorum*, yellow creeping loosestrife, *Polygonum bistorta*, and many other favourites.

Ferns were, of course, plentiful, clothing the rocks with their delicate fronds. Of these the principal were *Polypodium dryopteris*, the oak fern; *Polystichum lonchitis*, holly fern; *Lastrea rigida*, rigid shield fern; *Asplenium viride*, green stemmed asplenium (these three being the rarest of the ferns); *Asplenium tricomanes*, black spleenwort; *Scolopendrium vulgare*, harts tongue; *Blechnum spicant*, hard blechnum; and *Cystopteris fragilis*, brittle bladder fern. Of the fern-allies there were *Botrychium lunaria*, moonwort, so named from the shape of the spore-cases; and *Ophioglossum vulgatum*, adder's tongue; and on the highest range of the Scar three club mosses, *Lycopodium clavatum, L. selago*, and *L. alpinum*, rewarded the botanists. When the summit of the mountain was reached, Ingleton in the hazy evening light looked very far away, and, as there was such an unromantic thing as a train to catch and not much time to get to it in, the party bade farewell to the plants and Ingleborough, and hastened down the Scar, and after a rather rough walk reached Ingleton about six o'clock. After tea the Ingleton and Ribblehead sections compared notes, and several good plants were added to the already successful list. These were:—

Ophrys muscifera, the lovely little fly-orchis, with its velvet-brown, fly-like flowers; *Polygonatum officinale*, the wild Solomon's seal, which has a stem inclining to one side and alternate ovate leaves, all usually turning to one side; the flowers are greenish-white, and hang down from the axils of the leaves, solitary or two together. These two, with *Carex sylvatica*, were specially recorded by the president of the club. *Carduus heterophyllus*, or melancholy thistle, was another of the good plants found; it has large, solitary flower-heads of a bright purple, and it is not prickly like others of its order, but the leaves clasping the stem are soft and very white and cottony beneath; the stems are tall and deeply furrowed.

Paris quadrifolia, herb Paris, found on the wooded banks of the Greta, is a curious plant, with a simple stem and four, and sometimes more, leaves in a whorl. The flower consists of linear segments, green and yellow; the berry, of a bluish black colour, is used medicinally. *Convallaria majalis*, the lily of the valley, which grows in profusion on the wooded banks of the river, was the botanical enigma for the day; only a few specimens were in flower. This plant was also found by the Weathercote party. *Listera ovata*, twayblade, a green orchis, with two ovate leaves, and *Polypodium phegopteris*, beech fern, with its soft, downy fronds, ended the list.

By the invitation of the president, the club was joined at tea by Mr. R. R. Balderston, author of a very comprehensive work on "Ingleton: Bygone and Present," with a descriptive narrative of the physical features of the district, including botany, zoology, geology, and meteorology, and many matters of local interest.

A very pleasant journey home ended this most successful and enjoyable excursion, the vasculums of the members containing plants which might well fill the hearts of less favoured botanists with envy.

EMILY M. WOOD.

Societies and their Summer Work.

THE fine weather which has been general almost throughout the country has favoured the field clubs in their excursion arrangements. In addition to the meetings more fully reported under the head of "Societies" in another column, we may mention that some very interesting summer gatherings have been held by several scientific societies, the full particulars of which did not, in every case, reach us in time for fuller notice.

Thus, in the north of England, the Manchester Scientific Students' Association have devoted some attention to the study of the Equisetums, upon which Mr. Hyde gave a useful lecture during their meeting at Alderley Edge. In the same city other societies have been no less active, the Field Naturalists' Society having visited the Manchester Ship Canal Works at Latchford, a subject of never-failing interest to the inhabitants of Cottonopolis. Under the guidance of Alderman W. H. Bailey, much valuable information was obtained by the members.

In Manchester, also, the Microscopical Society have studied the life history of the silk moth, of which an account was given by Mr. M. L. Sykes; the Conchological Society were entertained with a description of *Zonites algira*, a mollusca from the south of France, which is a veritable tiger of its race; the Geological Society have visited the Barton Ship Canal section, and discussed the effects of the presence of carbonic acid gas in mines; whilst the Geographical Society, at a *conversazione* in the Memorial Hall, listened to an instructive address by Mr. J. H. Silberbach on "The Teaching of Elementary Commercial Geography in Primary and Secondary Schools," and also on other occasions were favoured with valuable papers on the

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"Jews of Morocco" by Mr. J. Thomson and Mr. B. J. Belisha, and on "Australia" by Mr. W. Ashburn. The Manchester amateur photographers, too, have been busy with summer rambles.

The Yorkshire Naturalists' Union held their seventy-eighth meeting at Huddersfield for the investigation of the Holmfirth district. After their explorations Mr. C. P. Hobkirk took the chair, and reported that the Union was making good progress.

At Leeds, the Naturalists' Club and Scientific Association is conducting successfully its operations, the members of which during the past month had an enjoyable excursion to Parlington Park and Aberford. The Leeds Co-operative Society also has attached to it a "Field Naturalists' Club," which recently visited Bramhope and Arthington in pursuit of botanical specimens.

We defer until next month more detailed reference to the various meetings of the Leeds Geological Association, which is most assiduous in its investigations into the geology of the district. During the past month excursions have been held at Wormauld Green and the locality of the "Haddockstones," a group of isolated blocks of gritstone of some interest. Another excursion was made to the vicinity of Craven, where the Langcliffe lime quarries and the celebrated Victoria Cave were visited, the members afterwards proceeding to Giggleswick. At an evening meeting of this Association, Mr. W. H. Filton read a paper entitled "One of Nature's Gems," in which he dealt with the interesting question of "What is Coal?"

Societies.

SOCIETY OF CHEMICAL INDUSTRY.—The annual meeting of this society will be held this year in London, under the presidency of Mr. Ludwig Mond. On Wednesday, July 10th, 1889, a general meeting will be held in the theatre of the Royal Institution, at 11 a.m., to receive the report of the council and treasurer's statement, and elect office-bearers and council. After this the president will deliver his address. After the meeting, the laboratories and historic collections of the Royal Institution will be open to members. In the afternoon the members will assemble at the art pottery show rooms of Messrs. Doulton and Co., on the Albert Embankment, to visit the studios and chemical sanitary potteries, or, as an alternative visit, will assemble at 3 p.m., at the porch of Lambeth Palace (by special permission of His Grace the Archbishop of Canterbury). In the evening, at 9 p.m., the president will hold a reception and *conversazione* in the Grosvenor Picture Gallery, Bond Street. On Thursday morning, July 11th, at 10 a.m., a steamer will await members at the Old Swan Pier, close to Cannon Street Station, and call at Charing Cross, 10-15, Westminster, 10-20, Chelsea, 10-40, for the Manbré Saccharine Company's Works, which will be reached about 11-30 a.m.; or members unable to meet the steamer can proceed to these works by District Railway to Hammersmith. After inspection of the Saccharine Works, the steamer will proceed to Kew Gardens. The director, W. Thiselton Dyer, Esq., M.A., F.R.S., has kindly consented to arrange for conducting the members over those portions of the gardens and museums having technological and scientific interest. The annual dinner of the society will be held on the Thursday evening, at the "Star and Garter," Richmond. Friday, July 12th, will be devoted to visits to the following works:—Messrs. Truman, Hanbury, Buxton, and Company's Brewery; Messrs. Cowan's Sugar Refinery, Barnes (near Hammersmith Bridge); the New Kingston and Surbiton Sewage Works (A. B. C. Process); the Brush Electric Light and Engineering Company's Works, Belvedere Road, Lambeth; Brins' Oxygen Company's Works, Horseferry Road, Westminster; to witness Mr. L. A. Groth's Electric Tanning Process, Messrs. Tebbitt Bros., 48, Tanner Street, Bermondsey.

ROYAL GEOGRAPHICAL SOCIETY.—At the anniversary meeting of this society, held on 27th May, in the hall of the University of London, General R. Strachey, president, in the chair, the report was adopted and medals for the encouragement of geographical science and discovery were presented, as follows:—The Founder's medal, to Mr. A. D. Carey (Indian Civil Service), for his remarkable journey in Central Asia, at his own risk and expense, during which he travelled over a distance of about 4,750 miles; also for a *resumé* of his travels, and map contributed by him to the society, by which he has rendered a most valuable service to geography; the Patron's medal, to Dr. G. Radde (Director of the Natural History Museum, Tiflis), for a life devoted to the promotion of scientific geography, as a traveller, observer, and author. The Murchison grant, for 1889, was given to Mr. F. S. Arnot, towards providing and conveying a suitable present to the Chief Chitambo of Ilala, as a recompense for his services in connection with the removal of the body and personal property of Dr. Livingstone, in 1872. The Cuthbert Peek grant was also presented to Mr. Arnot, in recognition of the interest and value of his seven years' travels in Central Africa. Mr. F. C. Selous was awarded the Back Premium for 1889, in acknowledgment of the geographical work accomplished by him in his recent journey in Mashunaland and North of the Zambesi. The Gill Memorial was presented to Mr. M. J. Ogle (Indian Survey Department), in recognition of his excellent survey work in Eastern Assam, Manipur, and in Northern and Western Burmah, partly with Colonel Woodthorpe, and partly independently. The scholarships and prizes given by the Royal Geographical Society to students in the training colleges, for 1889, were also distributed. The president then delivered his address on the progress of geography during the year. He said the arrangements to which the council had given effect during the last two or three years, with a view to the improvement and extension of geographical education in our own country, had continued in successful operation. Proceeding to review the progress of exploration and the chief geographical events of the year, the first subject, he said, which presented itself was the remarkable journey of Mr. Stanley through the hitherto unknown country lying between the great bend of the Congo and the Albert Nyanza. They must all have appreciated that the difficulties and dangers of the region he had to traverse had been by no means over-coloured in the great traveller's letter, and have felt increased admiration for the indomitable resolution, the courage, resource, and endurance which he had displayed in this latest of his numerous achievements. To throw full light on the wide tract of continuous tropical forest in the heart of that continent, and on such matters as the distribution of the dwarf race in the interior, formed a topic of singular interest, and showed that further and more systematic observations were necessary. The subjects were of so much intrinsic scientific importance, that there would probably be no lack of workers in so attractive a field in the near future. Considerable additions had been made during the year to our geographical knowledge in many parts of West Africa; but in East Africa, the most striking achievement had been the discovery of a great lake, some 300 miles to the north-east of Victoria Nyanza, by the adventurous Hungarian traveller, Count Teleki. After referring to the progress which had been made in the work of exploration in Madagascar, General Strachey proceeded to speak in detail of the extensive operations, both by actual surveys, explorations, and reconnoissances, that had taken place in the Indian Empire, Upper Assam, New Guinea, and other parts of the world, and stated that on a review of the recent progress of geographical knowledge the reflection could hardly be avoided that, great as had been the advance of exploration in Africa during the last 20 or 30 years, the interest of geographers would in the immediate future be more and more centred in the continent. Excluding the Polar Regions, there was no considerable portion of the earth's surface, unless in Africa, the essential geographical features of which had not been delineated. The formal business of the meeting was afterwards proceeded with.

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GEOLOGICAL SOCIETY OF LONDON.—At the meeting on 8th May, the following communications were read :—(1) "On the Rocks of Alderney and the Casquets," by the Rev. E. Hill, M.A., in which the author described the island of Alderney, with its surrounding reefs and the remoter cluster of the casquets. Alderney itself consists of crystalline igneous rocks, hornblendic granite of varying constitution, pierced by dykes, the eastern part being composed of Stratified rocks, the "Alderney Grits," belonging to the Upper Cambrian of Sapworth. (2) "On the Ashpington Volcanic Series of South Devon," by the late A Champerdowne, M.A. This series comprises tuffs and lavas, the latter being sometimes amygdaloidal and sometimes flaggy and aphanitic. The beds are intercalated in the Devonian group of rocks. Evidence for their stratigraphical position was adduced by the author.

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LIVERPOOL GEOLOGICAL SOCIETY.—As was to be expected, the great engineering work of excavating the Manchester Ship Canal has displayed a succession of fine sections of the greatest interest to geologists. The Barton division of the work (in the neighbourhood of Eccles and Patricroft) exhibits perhaps one of the most interesting series of sections, and these formed the subject of a very successful field meeting of the Liverpool Geological Society on the afternoon of Saturday, May 29th. Dr. Ricketts, F.G.S., first called attention to the special points of interest to be seen, and Mr. P. F. Kendall, F.G.S., of Owens College, who joined the party, afforded much valuable information. The river Irwell in this neighbourhood has a very sinuous course, and the line of the canal is carried sometimes in many parts through portions of the old river deposits, laid down during former oscillations of the river channel. Very fine sections of river gravels and sills—in some parts wonderfully cross-bedded, in others looking very much like sand dunes, full of rootlets—were to be seen. A large number of trunks of oak and other trees were contained in these gravels, for the most part in a good state of preservation and thoroughly blackened. It was interesting to see in the bed of the present river a stranded tree trunk in process of being embedded in the sand and mud of a bank now forming round it, furnishing an immediate illustration of the manner in which geologists of the present day seek to find in natural causes now in action means for the interpretation of the records of the past. In some parts hazel nuts in large numbers have been found, many of them drilled by squirrels and other animals. The exact spot was pointed out where, during the excavations, an old canoe was found at a depth of some 30 feet from the surface, embedded bottom upwards in the sand. The canoe, which was dug out or burnt out from the trunk of a single tree, is between 13 and 14 feet in length, and is now preserved in the Museum of Owens College, Manchester. The excavation in one portion visited had passed through a somewhat local deposit of boulder clay, and numerous fine specimens of boulders, or erratic blocks, were to be seen in the cutting. It was very noticeable in connection with these how very numerous the blocks of coal-measure sandstone were compared with their number amongst the erratics of the Liverpool district, and the members were much interested by Mr. Kendall pointing out also some blocks of fossiliferous Permian. The excavations are, in some portions, almost entirely carried on in the Bunter beds, and in most the lower mottled sandstone and pebble beds are well represented.

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A GEOLOGIST'S "AT HOME."—The Rev. P. B. Brodie, F.G.S. (president of the Warwickshire Field Club) and Mrs. Brodie gave an "At Home" on May 15th, at the Warwick Museum, from 3-30 to 6, when upwards of 200 guests received invitations. The chief object was to draw attention to the valuable Museum which was noticed in the May number of the *Research*. The various departments of the Museum were under the care of the following stewards, who kindly undertook to exhibit the principal objects of interest :—Archæology, Mr. W. Fretton, F.S.A., and Mr. Stanley; Geology, the Rev. P. B. Brodie; Botany, the Rev. G. Pinder, and Mr. Bromwich; Numismatics, Mr. Cove Jones; Mineralogy, Mr. Beresford Wright; Conchology, Miss F. Taylor and Miss Baly; Ornithology, Mr. Barrett, and three microscopes shown by Dr. Miles Atkinson, Mr. J. S. Baly, and Mr. James Baly. During the afternoon Mr. Brodie gave a very interesting and scientific description of the geological specimens, the collection of fossils from the Keuper sandstone, he pointed out, was acknowledged to be unique and almost priceless; every specimen had been examined by Huxley and Lyell, and named by Newton. Mr. James Parker, of Oxford, delivered a short lecture on "Geology in its Correlation with History." Among the local objects of interest collected in the Museum is part of a large fossil tree from Allesley, given by the late Rev. W. T. Bree, which is thought to be probably Permian. Light refreshments was served in the Bird Room, which was tastefully decorated for the occasion.

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HULL GEOLOGICAL SOCIETY.—On Whit-Monday the members of this society followed up their investigation of the Cretaceous rocks of Yorkshire by an excursion to Acklam Brow, the extreme N.-W. corner of the Wolds, where the base of the formation is admirably seen at an elevation of about 600 feet above sea-level. The party, accompanied by Dr. F. F. Walton, F.G.S. (president of the society), was met at Burdale by the Rev. E. Maule Cole, M.A., F.G.S. (vice-president), who undertook the leadership for the day. The leader first directed their attention to the springs at Burdale station, issuing from a band of Red Chalk, resting on Kimeridge Clay, which prove that the Cretaceous rocks are completely cut through in the dales, at the highest ridge of the Wolds, by denudation, on the *inner* or eastern side of their circumference—a fact long known to him, but only recently corroborated by the Geological Survey. Climbing the slopes of Fairy Dale, a halt was made at the Fairy Stones, a projecting mass of breccia, 200 feet above the springs, and 550 feet above sea-level. Here the leader pointed out the identity of the formation with the celebrated St. Austin's Stone, near Drewton, and explained how a mass of hard chalk and flints had been pushed, probably by ice, into a long rift in the chalk, and then welded together by its own siliceous cement into an extremely hard material, which withstood ordinary denudation better than the surrounding soft chalk rock. A rise of another 110 feet took the party to a ridge on the top of Burdale tunnel. Pursuing their journey, the leader took the opportunity of pointing out *en route* some of the peculiar physical features of the dales, which are unique in England; showing how they could not possibly have been scooped out by ice, which plays an infinitesimal part in wearing away its bed, nor by running water, which, under ordinary circumstances, does not exist anywhere on the chalk Wolds, but by the action of the rainfall, working through lapse of ages on inequalities of the surface. A magnificent example was shewn in Water Dale, whose steeply sloping sides rise to a height of 200 feet above the narrow level bottom. Arriving at Brown Moor Dale, the chalk, at an elevation of 600 feet, was still found to have been completely cut through by denudation, the bottom of the dale consisting of Kimeridge Clay. Soon the water-parting was reached at an elevation of 751 feet, where a supposed Roman road crosses from Malton southwards to Garrowby Street, and, from a tumulus close at hand, a most magnificent view was obtained of the Plains of York, Mowbray, and Pickering, with the surrounding hills of the Penning, Hambleton, Moorlands, and Tabular Hills, stretching from Goole on the Humber, round by Selby, Leeds, Harrogate, Thirsk, Pickering, to Scarborough, whilst York Minster stood up like another Bass rock right in front. Without doubt this is one of the finest views to be seen, even in Yorkshire, and deserves to be more generally known. The party were afterwards conducted to the scene of the landslip on Leavening Brow, described by Mr. Hill (*Quart. Journ. Geol. Soc.*, vol. xliv., pp. 333, 341), where an interesting Neocomian bed (six inches) of yellowish sandstone,

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containing numberless minute rounded pebbles of quartz and iron in an oolitic matrix, was carefully examined. The Red Chalk here reaches its highest point above sea-level, viz., 600 feet. Returning along the northern brow of the Wolds, which here rests upon Kimeridge Clay, underlaid by rocks of the Middle Oolites, a splendid example of a "nab," similar in all points to the nabs on the northern escarpment of the Tabular Hills, was shown in Mount Ferrand, a projecting promontory half-way down the north side of the Wolds, consisting of Lower Calc. Grit on the top, Oxford Clay on the sides, and Kellaway's Sandstone at the base. These nabs are characteristic of this particular geological formation, and may be traced all round the vale of Pickering on the *outer* margin. A baronial castle, belonging to the Fossards, A.D. 1150, once stood on Mount Ferrand, but no traces are left. Ascending to Aldro, the leader gave an address on the fine entrenchments and tumuli with which this corner of the hills is covered. The party returned by Water Dale to Thixendale, where they witnessed a tiny stream, issuing from the base of the Chalk, and running on the surface one mile to Raisthorpe, where it sinks in the valley gravels. The only other example on the whole of the Wolds is a similar beck, which flows from Wharram-le-street to Weaverthorpe, All the dales in the Chalk, with these two exceptions, are dry valleys.

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YORKSHIRE GEOLOGICAL AND POLYTECHNIC SOCIETY.—A general meeting of the members of the Yorkshire Geological and Polytechnic Society was held on 8th May, at Malton, Mr. J. H. Phillips, curator of the Scarborough Museum, presiding. Mr. G. W. Lamplugh read a paper on "The Sequence of the Beds at Speeton and their Foreign Equivalents," which dealt with the clays below the chalk at Speeton, a section that was of very great interest and importance to all students of secondary rocks, whether in England or on the Continent, because it was only at Speeton that there could be found a complete section of the Lower Cretaceous, and the junction of the Cretaceous and Jurassic formations. Anyone going to Speeton in winter would see very little. It was only by living near the place, and examining the section under all sorts of conditions, after rough weather especially, that anything could be seen. At such times, and especially after the autumn or spring storms, the sea beach was often exposed, and by that means the various beds could be very much better examined than in the tumbled cliffs. In this way, and by going constantly in all sorts of weather, and mapping together all he had seen at different times, he had been able to make a plan, of which he displayed a copy. The strata had already been classified by Phillips, Leckenby, Judd, and others, but owing to the great difficulties which the section presented the results had proved in some cases doubtful. By constantly examining the shore he had been able to arrange a vertical section throughout the whole of the clays, and the result was to make considerable alteration in the existing classification. He proposed to carry the limit of the Jurassics higher in the clays than had yet been done, including in that system a zone of *Belemnites Lateralis;* also to abolish the term *Middle Neocomian*, and was of opinion that the evidence showed that there was no unconformity between the clays and the red chalk. In this portion of his paper, Mr. Lamplugh dealt at length with the classifications previously made by Leckenby in 1859, and Judd in 1868, and in combating the unconformity theory of Professor Judd—which, he said, was based on an examination of the tumbled cliff, and not of the exposed beds in the beach—he said that the red chalk was accepted as the equivalent of the galt, or its upper part, in the south of England, and it was supposed there was a strong unconformity between the red chalk and the Neocomian clays, this unconformity being stated to be the most striking in England. No doubt there was a great unconformity inland, but in Speeton the evidence of these beds seem to show there was no unconformity; and, in fact, that while a little way inland—at Malton probably—they had dry land forms, at Speeton, fifteen or eighteen miles away, they had a deep sea still existing. He then dealt with the fossils discovered in the Speeton clay and the red chalk, and argued that there was strong evidence of a passage from one to the other. At Speeton they had fossils from undoubted Jurassic rocks—the upper cretaceous rocks; that was, Speeton had remained a sea bottom during the whole of the Cretaceous period--from the period of the upper Kimmeridge to the period of the Upper Cretaceous, and if they were to go lower down, he had no doubt they would find the sea bottom had extended through the greater part of the Jurassics. It was evident these beds were at the edge of an ocean that extended eastward over Germany and Russia. His classification brought the section in close accord with the Russian, French, and Swiss sections, and it was at Speeton, he believed, that those foreign geologists would find the key to their own divisions. He expressed the strong opinion that, at the period he had been dealing with, one ocean, as he had stated, stretched away over Prussia and Russia, and that it was separated by a ridge of land from another ocean whose shores were in Lincolnshire, and whose deeper water lay to the south, over France and Switzerland. The physical conditions under which those clays were deposited had evidently been in deep water, not far from the shore line, and during the deposition of these clays the ridge of land lying to the south-west was being rapidly denuded, so that the red chalk, inland, showed a line of great unconformity.

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YORKSHIRE NATURALISTS' UNION.—On Whit-Monday an unrivalled opportunity of studying the geology of the wild and romantic moorland district lying south-west of Holmfirth was afforded by an excursion of this organisation, for the purpose of inspecting good sections of those divisions of the Millstone Grit series known as the Third Grits and the Kinderscout. The party had a very practical and able leader in Mr. Joseph Field, of Huddersfield, who has closely studied in detail the geology of the district; and they further had the advantage of the well-known experience of Mr. James Spencer, of Halifax. The party on leaving Holmfirth station proceeded in the direction of Holmebridge. It was a gradual ascent all the way from 460 feet above sea level at Holmfirth to 610 feet at Holmebridge; on either side lofty grit-capped hills lined the valley. They now left the main road and turned on Brownhill Lane on the way to Ramsden Clough, passing on the way the two reservoirs recently constructed for the water supply of Batley. They were now at an elevation of 800 feet, and before then the dark, imposing heights of Ramsden Edge, Holme Moss, &c., rose steeply to an altitude of 1,600 feet. These heights are capped by the Third or Middle Grits, and as the shales underneath weather away the superincumbent rock falls off at its jointings, and the escarpment continues to preserve its characteristic wall-like character. Here and there the mountain streams cut their way into the escarpments, forming dikes or cloughs, in which may be seen leaping silvery cascades. Ramsden Clough is a fine section of the Third Grits series, about 550 feet in thickness, overlying the Kinderscout Grit. The latter forms an inlier in the valley, and the lowest bed in the series is quite a conglomerate. Mr. Field then described the succession of the beds composing the Third Grits, and recounted the divisions of the same by the Geological Survey, who for these various sandstones employ the letters A, B, C, and D. The escarpment of Holme Moss alluded to is in the Division B. Netherby Clough was decended and the steep ascent made of Netherby Brow to the quaint and isolated village of Holme, which stands in a fine position, about 1,000 feet above sea level, and is surrounded by majestic scenery. Although the tiny village was astir with Whitsuntide excitement, yet the "Fleece" was expansive enough to admit the party for sorely-needed refreshment. Near the friendly gable of Mr. Beardsall's house, Mr. Field gave a short address upon the geology of the district, explaining the salient points and positions of the beds. The way was then taken briskly down Fieldhead Lane to Digley Wood. The shales above the bank of the Bilberry Mill reservoir were examined, and a thin seam of

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coal was seen. At Good Bent is the Kinderscout Conglomerate. They passed next on Gibriding Lane, and gradually ascended to Green Gate, an elevation of 1,100 feet. On the way the evidences of the fault which extends nearly from Meltham to Holmebridge were pointed out; a little to the east of Austonley the top of the Kinderscout Grit is thrown against a sandstone of the Middle Grits. A little detour was made from the road to visit a quarry, in which there is a thin seam of coal in the A sandstone of the Middle Grits. Some small fossils, probably Stigmarian rootlets, were here obtained by Mr. Spencer. It is known as the Upper Meltham or White Rock coal. In the sandstone was noticed a large concretion with concentric rings. From the summit of this quarry Mr. Field detailed the surrounding scenery. To the south were the wall-like heights of Holme Moss, succeeded on the east by a splendid series of step-like escarpments. On Shailsden Moss, near Cook's Study, was one formed by the Second Grits or Flags, to which succeeded those formed by the Soft Bed Flags, the Forty Yards or Loxley Edge Rock, the Eighty Yards Rock, and the Elland Flag Rock or Green Moor Rock of the Huddersfield district. Then the Grenoside Rock, on which the erection known as "Tinker's Folly" is built, was pointed out, also the Rough Rock below Thurstonland. Turning round, the isolated height of Castle Hill was very prominent, and West Nab also was well seen. This lofty hill is capped by the Rough Rock, and there are some remarkable weathered masses of rock strewn about, no doubt from landslips. A brief but refreshing rest at the Ford was allowed, and the road was resumed to Holmfirth, having on our right the gorge of Hart Hole Clough, cut into the shales by the tiny beck. The train was taken to Huddersfield, where a meeting of the Geological Section was held. Mr. J. W. Davis, F.G.S., occupied the chair, and a brief *résumé* of the day's work was given by Mr. S. A. Adamson, F.G.S., one of the sectional secretaries.

Obituary.

Robert Damon, F.G.S.—The death is announced of this well-known geologist and naturalist, at his museum at Weymouth, on 4th May. Mr. Damon had been a great traveller in many parts of the globe. There were few countries in Europe which he had not visited, and he had penetrated into Asia and Africa. Some few years ago he undertook an expedition to Russia for the purpose of collecting the fishes of the Caspian Sea. His collection of shells was one of the finest in this country. Some fine specimens of cretaceous fossil fish from Syria in the British Museum were obtained by him. For many years his own museum at Weymouth has been the resort of scientific men, by whom his loss will be keenly felt.

Warren de la Rue, F.R.S.—This eminent scientist passed away on 19th April, at the age of 74. During his long and active career he had distinguished himself in astronomy, and was one of the first to apply photography to the recording of celestial phenomena. The instruments originally used by him at his private observatory at Crawford were presented to the University of Oxford. In 1874 he carried on a series of elaborate researches on the electric discharge, for which he fitted up in his laboratory a battery of 15,000 chloride of silver cells. Mr. De la Rue was president of the Royal Astronomical Society from 1864 to 1866, and of the Chemical Society from 1867 to 1869. Three foreign Orders were conferred upon him in recognition of the value of his scientific labours.

Mr. William Beamont, of Warrington, whose death is lately announced, was a well-known antiquary, and the author of numerous works dealing with the local histories of Warrington, Latchford, Frodsham, and other places in Lancashire and Cheshire.

Mr. John F. La Trobe Bateman, who died on 10th June, has distinguished himself, throughout a long and active career devoted to the profession of engineering, by his special ability and aptitude for important water undertakings. Amongst the waterworks, in the construction of which he was engaged, was the celebrated aqueduct which supplies Glasgow from Loch Katrine. He was also connected with the Manchester Waterworks, both at Longendale and Thirlmere, besides many other similar undertakings in many parts of the country.

Letters to the Editor.

Notice to Correspondents.

It is important that Letters to the Editor should be as brief as possible and to the point, as it is difficult to find space for lengthy communications. Several letters received have been quite too long to be published in full, and we regret that we cannot find room for them in this number.

Insects and Plants.

Sir,—I can fully endorse many of the statements made in the article by Mr. E. D. Fish, in your last issue. I have had several letters from Miss Ormerod about warbles. My cows had scarcely one on them this spring. I killed all, or pretty nearly all they had on their backs last spring by putting a little mercurial ointment in each hole, and during last summer had their backs smeared with a strong solution of "Macdougall." I feel certain that if all farmers could be prevailed upon to do the same we might soon exterminate this pest entirely. As to the "Tipulæ" grub, it is one of the most destructive of farm pests. Some years ago I had two sowings of wheat in one season entirely eaten by the grub. It had completely eaten the first sowing by February. I sowed another lot in that month, and they eat that also. There was no cure, because they eat the blade from beneath the soil, pulling the young blade under as they eat it. Could we have had a flock of plovers or peewits, which feed at night, we might have got rid of a great many of them. However, at last we got a crop of barley. The "Turnip Beetle" would be bad to get rid of; it is so small and numerous, and feeds on so many weeds, that I am afraid the cure would be worse than the disease. The new machine, called the "Straunsmeyer," which is said to be able to distribute one gallon of paraffin per acre in a spray, might help us, but I think a more effectual remedy would be to distribute a shower of quicklime on the young plants when there was a dew on. The horse-warble, or bot, as we call it, might be considerably reduced if every horseman would singe the part of the horse when the eggs are deposited, as they are easily to be seen. I think the fly was much more numerous in Holderness than in this district. I have killed the fly many a time when it was about to lay its eggs on the horses when I have been ploughing. I have also seen in the stomach of a "yearling" as many of the larvæ, all in a heap, packed close together, with their mouths apparently fast to the membrane of the stomach, as would fill a quart measure. The "saw-fly" I am not familiar with, but can endorse what you say of the wheat-midge; it was very destructive to my crops during the damp seasons of 1885 and 1886.

W. H. Hutchinson.

Lockington Grange, near Hull, 14th June, 1889.

A Poisonous Trunk Fish. *Ostracion (bicostalis?)*

A gentleman residing at Montserrat, West Indies, gave me lately the following singular account of a trunk fish of that region. He said that if cast on shore by the waves, a circumstance of rare occurence, it became quite helpless, the only flexible part of the animal being its rather short tail, but when in its native element it was most dexterous in avoiding any such calamity taking place. He also stated another thing, viz, that it has two fleshy patches, one on each side of the body, which must be cut out before the flesh is cooked and eaten, otherwise the effect produced on the partaker of this dainty morsel is that of intoxication, and even the dogs eating the flesh containing these patches are similarly affected, and become ill. Some naturalists state that the liver of the trunk fish is poisonous. Are these patches in any way connected with the liver of the fish?

F. P. Marrat.

Free Public Museum, Liverpool.

Note.—Further particulars and authentic specimens of the remarkable species of fish above referred to would be desirable acquisitions to our Museum if sent carefully preserved in spirit.

T. J. Moore, Curator.

June 25th, 1889. *Liverpool Free Museum.*

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NOTICES.

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of news and important additions to their collections.

Communications intended for insertion in the followlng numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Science, Art, and Industry.

ONE of the most interesting events of the past month was the Annual Meeting of the Society of Chemical Industry, an Association now numbering nearly 2,500 members. This meeting was especially interesting—first, for the admirable address of the President, Mr. Ludwig Mond, in which he detailed his course of action and results of his investigations regarding the production of ammonia; secondly, for the manner in which Mr. Mond, Professor Dewar, Sir Lowthian Bell, Mr. David Howard, Dr. James Bell, and other speakers strongly urged a greater bond of union between Abstract and Applied Science; thirdly, for the short discourse from Sir Henry Doulton on the application of Art to the Pottery Industry; fourthly, for the opportunity afforded to the members of visiting several important manufactories and processes.

The mode of conducting his investigations adopted by Mr. Mond—first of all ascertaining what had already been done or suggested in a similar direction, and then testing by careful experiment the results previously obtained, sifting out what was useless and working only on what had proved true and valuable, and then gradually developing new researches with equally careful testing of each step—is the only true way of conducting research, and if such a method was more frequently adopted there would be far less of that faulty and incomplete work which now, unfortunately, too frequently passes for scientific research.

As regards abstract and applied science, the votaries of the former too often look with disdain upon efforts to make discoveries useful in the world's work; whilst the practical man too frequently disregards the teachings of pure science, and goes about his work by mere "rule of thumb," with no guide but a sort of haphazard guess that he is proceeding in the right direction. And hence the many blunders and disappointments and waste of time and money which attend very many new ventures in manufactures and other industrial operations dependent upon scientific principles. Therefore it is well that the importance of studying the teachings of abstract science by the practical man should be strongly insisted on, and, on the other hand, that the investigator in purely scientific paths should be brought to know that the knowledge which he obtains by his researches is all the more valuable if it can be employed in helping the world's progress.

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In the work of Chevreul, to whom we allude in another part of this issue, we have an excellent example of the advantages that can accrue from following up purely scientific research by efforts to make the results serviceable in practical directions. The enormous development of the soap and candle manufactures, with the consequent benefits which have accrued to commerce and industry, with increased comforts and luxuries to the community, will always stand as a grand testimony to the value of scientific research in its relation to practical life. And this is no solitary instance; for we can now turn in numerous directions and point to new manufactures, improvements in old methods, developments in engineering, agriculture, and other arts and industries, entirely due to following up the work of scientific investigators, and the greater is the success where the connection between science and practice is the closest.

Then, again, as regards Art and Industries: there can be no question that the combination of the beautiful with the useful is having a wonderful effect in the cultivation of higher and purer tastes amongst nearly all classes of the community, and, that being so, we can only hope for still greater strength in the union.

It is highly satisfactory to find in an important association such as the Society of Chemical Industry the opinion so strongly pervading it that there must be a close union of abstract and applied science to ensure complete success in either. We hope in other societies and amongst all classes whose work has connection with science a similar feeling will prevail, for, if so, the progress of the world will be materially hastened.

Granite,

From a Geological and Economic Standpoint.

By J. Shearson Hyland, Ph.D., M.A.
(*Of H. M. Geological Survey of Ireland*).

Part III.—Concluded.

GRANITES were originally held to be the oldest rocks, the foundation on which all other rocks have been laid down. This once firmly held tenet had to be abandoned, as geologists showed that granite invades and alters rocks of all ages.

In selecting a stone for utilisation in the erection of a permanent structure, special attention must be paid to the climate and locality. If the district be one where the annual rainfall is heavy, or where the rain or atmosphere is likely to contain a fair percentage of free acids, great care must be exercised. On the other hand, in a dry or rainless climate, such as that of Egypt, stone of almost any kind lasts unimpaired for indefinite periods. Of this the most notable illustration is, according to Professor Hull,[1] the pyramid of Cheops, upwards of 4,000 years old, which is built of Nummulite limestone. Similar instances are known in India; hence, as the climatic influences in such countries are of small moment, we will confine ourselves to agencies at work in humid districts.

In the first place, it is a well-known fact that stone of any kind weathers better in the country than in the town. The presence in the atmosphere of the latter of sulphurous, hydrochloric, and similar acids, which practically play the part of solvents, has a very destructive effect.

From an economic point of view, the position of the quartz, as the last constituent to solidify, is of great importance, as bearing upon the durability of the granite. This subject has, however, already been treated above. The felspar also plays an important part. Its constitution, its condition with regard to decomposition, should be noted; further, the discolouration it has undergone. The presence of felspars, which contain much lime, and thereby approach the constitution of the so-called Lime-Felspar or *anorthite*,[1] is undoubtedly against the durability. The felspar in granite is mostly a potash felspar, *i.e.*, an *orthoclase*, which withstands decomposition much better than either the soda or lime felspar, but instances are known where the latter play such an important part in the constitution of the rock as to affect in no small degree its durability as a mass. The decomposition of felspars is considered to be due to the percolation of water containing dissolved CO_2, and no felspar is able to withstand this agent of destruction. The felspars, consisting of Silicate of Alumina and Silicate { Lime, Soda, Potash, } are attacked chemically by the water, with the formation of carbonates of these bases and the liberation of silica.[2] The crystals lose their lustre and colour, become turbid and earthy, and are finally converted into a soft clay.[1] By this process the whole of the alkali, together with two-thirds of the silica, is removed, leaving behind a hydrous aluminous silicate, known as kaolin.

Again, attention should be given to the easily decomposable accessory minerals containing protoxide of iron, which, after oxidation, are usually hydrated, becoming brown in colour. Sulphides of the metals, *e.g.*, iron pyrites, &c., may give rise to sulphates, and sometimes to the liberation of free sulphuric acid.

Another very powerful factor in deciding the durability is the property the rock possesses of absorbing water. All granites contain a certain amount of water, which is not, however, chemically combined, but is absorbed among minute joints and pores. This water is often termed "quarry-water" (*eau de carrière*). Most of it evaporates when the stone is removed from the mass *in situ* and exposed to the atmosphere. The absorbent powers of all rocks vary greatly, and is naturally proportional to their porosity. Granite absorbs on the average 0·37%; but this amount may be increased by exhausting the air from the specimen and then immersing it in water[1]. In addition to the chemical action of the water, there is also a mechanical effect produced by its freezing. When water freezes it expands, and very great pressure is needed to counterbalance this power, which increases as the temperature sinks. In Nature this expansive power is rarely, if ever, neutralised; hence, rocks have their particles pushed asunder by the freezing of the quarry-water in their innumerable fissures and joints. When the ice melts the separated masses do not resume their original position; hence disruption becomes by degrees prevalent. The greater the absorbent power of the rock the less it may be said to be durable.

The comparative resistance of a granite to thrusting stress is also, according to Mr. Harris (*Granites, and our Granite Industries*, London, 1888), worthy of note. The weight, he remarks, necessary to crush a stone varies with the state of cohesion and hardness of its components. This test may give good results, for the strength of a stone is naturally only the strength of its weakest part.

The density is an important point, and is, to a certain extent, a test of the compactness and durability. A determination of this is especially useful in selecting granite for marine works. For

[1] *Building and Ornamental Stones*, 1872. Page 304.

[1] Anorthite possesses about 20 per cent. of lime.

[2] Cf. Roth. *Allg. Geologie* I., p. 112.

[1] At the present time more than a quarter of a million tons of china-clay are annually prepared from decomposed granite in Cornwall and Devon. *Mineralogical Magazine*, 1887, vii., No. 35, p. 207 (Collins).

[1] cf. Delesse. *Bull. Soc. Geol. France.*, xix., 1861-2, p. 65; also, Geikie, op. cit. p. 282.

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information upon this point reference may be had to Mr. Harris' work quoted above, also to T. Stevenson's *Harbours*.

The "jointing" of a granite affects the durability, and the facility with which it may be quarried. As a rule, the joints are closer in the finer grained varieties than in the coarser grained; hence, where large blocks are required, the coarse grained granites are more suitable.

In countries where great variations in the temperature exist, the contraction and expansion prevents the masonry from remaining close and tight.

Strange though it may appear, granites are very susceptible to injury by fire, much more so than compact sandstones with a siliceous matrix.[1]

Although a great deal of granite is used for road-metal, yet by far the greatest quantity is employed in dock-works, kerbs, and ornamental work. For cut-stone purposes the intrusive granites are much superior to those of metamorphic origin, as in the former, with but few exceptions, there are systems of what the quarrymen call "grains." These are lines often recognisable only by trained persons, along which the stones generally split. In general there are two systems of grains, at right angles to each other, and hence the stones can be split up into rectangular blocks or slabs, capable of taking the dressing on any face.

We will now briefly mention a few of those granites which are particularly well-known through their utilisation in the erection of many of our public structures.

The granite quarries in Aberdeenshire are without doubt the most important in the United Kingdom. Their use is not confined to Great Britain, much of the material being exported. There occur two principal masses, which may be designated as Aberdeen and Peterhead. The former is generally of a grey or light blue colour, the latter being mostly pink or red. As far back as 1764 it was resolved to pave the streets of London with Aberdeen granite.[2] It has also been used, amongst other purposes, in the Tay Bridge, Bell Rock Lighthouse, and for the balustrade of Waterloo Bridge. Examples of the Peterhead granite, which forms one of our best building-stones, may been seen on the exterior of the Carlton Club, at St. George's Hall, Liverpool, and round the fountains at Charing Cross.

The Kirkcudbrightshire granites have been used amongst others for the construction of the Liverpool and Birkenhead Docks, and the Liverpool Borough Bank. It is of a greyish colour, and is usually porphyritic. The Dartmoor granite is principally greyish, and a large portion of London Bridge was built of it. That from the Gunnislake Quarry was used for James Street Station, Liverpool. The granite from Cheesewring, Cornwall, was employed for London Bridge, Westminster Bridge, Thames Embankment, Docks at Copenhagen, &c.

In Ireland good granites are frequent. From Killiney Hill (Carnsore Point) enormous quantities have been extracted for the construction of the harbour and pier at Kingstown, Thames Embankment, and O'Connell's Monument in Glasnevin Cemetery, Dublin, besides numerous structures in and around the Irish metropolis. There is, however, according to Professor Hull, considerable variation in the durability of the stone, and great care should be exercised in the selection. Granite from the Blessbrook Quarries, near Newry, has been extensively used in Liverpool, London, and Manchester for paving sets. Newry granite forms the quays at Bucharest. The Co. Down granite was employed for the base and pedestal of the Albert Memorial in Hyde Park; it was further used in the re-construction of the Bishop Rock Lighthouse, Scilly I., and is considered well adapted for fortification purposes as the result of experiments made at the Royal Arsenal, Woolwich.

It is impossible to afford in the space of this article further particulars upon this subject. Those who desire more special information must refer to the several books published on this question. The work by Mr. G. F. Harris, on *Granite, and our Granite Industries*, is highly to be commended for this purpose, whilst those who specially require information on the Irish material can be referred to the paper on "Granite and Metamorphic Rocks of Ireland," read before the Royal Dublin Society last year by Mr. G. H. Kinahan, than whom there could be no abler authority.

[1] Harris, op cit., p. 133. [2] Bremner. *Industries of Scotland*, p. 405.

Geological Photography.

MR. S. A. ADAMSON, F.G.S., writes on this subject as follows:—

"The value of photography in geological field-work is a matter upon which all are universally agreed. The appearance of the photographer with his camera is always welcome, as by his means sections and physical features seen during the day's work are indelibly preserved, and form one of the pleasantest of reminiscences when in after days they are inspected again. They are, however, of still greater value; good sections in railway cuttings, quarries, gravel pits, &c., are very often of a most temporary character, and soon disappear. The camera, happily for the benefit of future students, preserves these perishable geological memorials. A striking instance of this was in connection with the visits of the members of the Leeds Geological Association a few years ago to several sections in the Lower Coal Measures at Hunslet and Newtown. The beds then viewed were all exposed in huge excavations made for the purpose of brickmaking, and, of course, as the work was at the time actively carried on, the sections would undergo change, and no doubt in time be inaccessible. Mr. Branson, F.C.S., however, luckily photographed them, and to this day and henceforth we have a permanent record of these valuable sections. Precisely the same thing occurred in the making of the Skipton and Ilkley Railway. Sections were then photographed by Messrs Wilson & Nichols which are now turfed over and lost to view. Similar work has been done in other counties, and with good results; but still all has been done in a somewhat isolated manner, without connection or method. Very often, too, when a good picture has been taken no record of it has been made, and thus its existence has been overlooked or forgotten. The question of registration of geological photographs was ably and pertinently brought before the British Association at the Bath meeting by Mr. Jeffs, of Liverpool, and it was agreed that something should be done to secure uniformity of action as well as the active co-operation of geologists and geological societies throughout the kingdom. The Council of the Leeds Geological Association have long recognised the importance of geological photography. Upon every excursion some able amateurs, as Messrs. Nichols, Bedford, Bingley, and others, accompany the members and add to the enjoyment and value of the work by the skilful use of their cameras. Accordingly, quite a number of valuable sections in the varied and interesting geology of Yorkshire have now been photographed, and lists of these will be sent to the British Association Committee of Delegates or placed before the Geological Section. It is well known, too, that many good geological pictures have been taken by individuals having no connection with scientific societies, and these will be difficult to obtain information upon. If any one who has thus done good service to geologists will kindly inform the secretary of the Leeds Geological Association (Mr. Adamson, F.G.S., 52, Wellclose Terrace, Leeds), or any views of this character, giving date of picture, name and address of photographer, and locality of sections or rocks, with any details which they may have, it would be warmly appreciated. The list thus received would be forwarded for registration, and the senders in the first instance would thus have done some good, practical scientific work of a character to be recorded and carefully preserved for future instruction and reference."

We may add that lists from other counties besides Yorkshire may also be sent to Mr. O. W. Jeffs, 12, Queen's Road, Rock Ferry, Cheshire, who has already received valuable lists of views taken for geological purposes in various parts of the country. Since attention was called to the matter in our columns, the subject has received notice in several directions. The following hints are so entirely *apropos* that we quote them as they stand from a "Note" in the last number of the *Transactions of the Liverpool Geological Association*.

"Speaking of the camera, it is pleasing to see how much photography is being utilised for geological purposes. Yet we fear that this development may be at the expense of the pen and pencil. There are many features, such as peculiarities of weathering, which readily lend themselves to the photographer's skill; still, even in these cases, the distinctive geological features are often obscured and rendered secondary by the desire to secure pictorial effectiveness. More than this, no photograph, however efficient, will compensate for the neglect of the note-book, and the useful habits and splendid training which its constant use supplies. It has been said, and not altogether unjustly, that a geologist who cannot draw is little better than a lawyer who cannot speak. Certainly this much is true, that where the sketch-book

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and note-book are in frequent requisition, there it is that the most valuable field work is likely to be accomplished."

Whilst advocating photography as an additional aid to geology, the writer of the article which appeared in our last number has already explained in a published paper that it is not intended to minimise the importance of sketching from nature when engaged in the field. A drawing, moreover, possesses this advantage over a photograph: it can be made self-explanatory. A natural surface of rock, or face of a cliff, is often obscured by vegetable growth, which would be reproduced in the photograph. The most useful method of illustration is, undoubtedly, to accompany the photograph—showing the section as it actually appears—with a detailed drawing explaining the features seen.

Llangollen and the Valley of the Dee.*

OF all the beautiful spots in which Wales abounds, there is none more charming than the lovely Vale of Llangollen. It has long been justly famed as a health resort, and the exquisite beauty of its walks and drives, and the neatness, cleanliness, and pleasantness of the town of Llangollen renders it especially attractive even to ordinary visitors, but to the artist it offers endless subjects for study and treatment, whilst the student of science can always find there a great store of objects worthy of the most careful attention.

We have already in our number for May, in an article by Mr. G. H. Morton, described some of the geological features of the district, but these represent but a very small proportion of what is there to be studied by the geologist. Indeed, so varied are the geological features of the neighbourhood, that, as has been well said by Mr. J. Parrot, "the whole palæozoic series of rocks may be studied to great advantage, embracing as it does, within a short ride or easy day's march, good geological sections, from the Lower Silurian, Upper Silurian, a strip of the Devonian, the majestic Carboniferous Rocks, capped with the Millstone Grit, to the Coal Measures near Ruabon," whilst the palæontologist will find it a perfect storehouse of fossils. An eminent geologist, Salter, once said of the mountain Fronfry, near Glenceirrog, not far from Llangollen, "that to work Mynydd Fronfrys for fossils was like working in a museum," and this is practically true of many of the deposits in the neighbourhood of Llangollen. Economic geology is also well represented by several slate and limestone quarries, coal, and metalliferous mines, and in a remarkable deposit of clay from which the well-known *terra cotta* ware is now largely produced.

With such a diversity of character in its geological strata, it can be well seen that there is much of very great interest to study in the physiography of the district, and, in the main and side valleys, on the hill slopes, and mountain tops are remarkable examples of the effects of atmospheric denudation. The river Dee, which flows through this valley, is a noble river, offering some glorious examples of river-scenery and the causes producing it; whilst from the more elevated parts can be seen panoramas of great extent and varying charm, and the visitor to Llangollen who wishes to study the scientific features of the neighbourhood will do well to first take a bird's-eye view of the whole neighbourhood so as to map out his plan of action. At the head of this article we give a view from the Geraint, or Barber's Hill, which rises right above the town of Langollen, which will give some idea of the scenery in the immediate neighbourhood of Llangollen.

From the eminence, topped by Castle Dinas Bran, on the other side of the river, from the moorland above the Eglwyseg rocks, and from

*The illustrations are from photographs by Valentine & Sons, Dundee.

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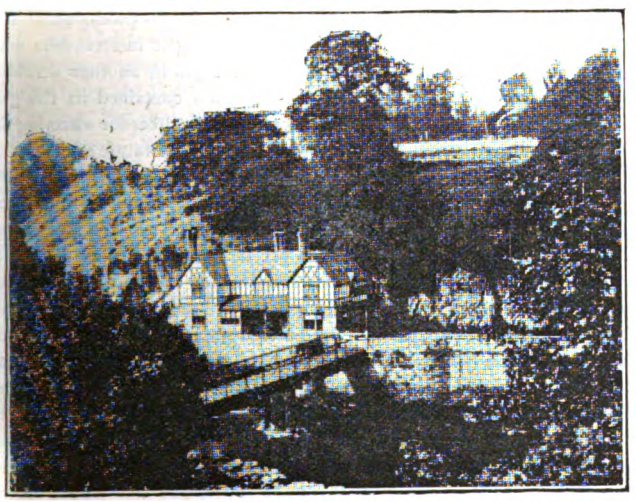
any other of the many eminences round about, excellent opportunities for viewing the surface features of the neighbourhood are afforded. Many visitors, we fear, are deterred by the somewhat laborious ascent from getting to the moorland above the Eglwyseg rocks, but not only are there to be obtained there some of the finest views of the neighbourhood, but also rich geological and botanical treasures.

And, if the geology is varied, the botany is more so, and this may well be imagined when it is remembered how great must be the difference in the character of the soil in different parts, owing to variation in geological features and other circumstances consequent upon differences in the surface characters. The river banks, hill sides, and mountain slopes are beautifully wooded, and the trees show most luxuriant growth. Many of the roads run through woodland, and the varying outline of the route through which they pass gives them such direction that to walk or drive along them is to obtain an ever changing panorama of a richly-wooded and fertile district. Flowering plants are, of course, in grand profusion, and ferns, mosses, lichens, and more lowly growths are present in great variety, especially in the numerous narrow valleys and ravines. Indeed, in every direction, even in the walls on the roadside, plants may be found which can afford the botanist exquisite pleasure and profit.

Then, again, in the river and in the canal the students of aquatic plant life have a rich field for study. Whilst the river is much sought after by the angler for salmon, trout and other fish, the canal is largely used by visitors for a quiet, pleasant sail in the comfortable barges which pass up and down it. This canal is fed by the river Dee from a point a little lower down the Dee than Llantysilio church and just below the seat of Sir Theodore Martin, and passes through well shaded banks, clustered with a profusion of such wild flowers as



Chain Bridge, Berwyn, near Llangollen.

delight in moisture. Our picture shows the Chain Bridge and Hotel, near Berwyn Station, but on the opposite side of the river, not far from the head of the canal, a charmingly picturesque spot, with a fine bit of river scenery.

Other subjects besides those referred to may well give occupation to votaries of science in this valley and on the surrounding hills. The entomologist, for example, will find here a happy hunting ground. Grand examples of engineering are also to be found in the Pont Cyssylltau Aqueduct and Great Western Railway Viaduct over the Dee. And there are many studies for the archæologist. Immediately facing the town are the ruins of Castle Dinas Bran, which is situated on the top of an eminence of conical shape, about 600 feet above the level of the river. This hill is formed of the upper shale beds (Wenlock), and is separated on one side only by a very narrow valley from the carboniferous Eglwyseg rocks, and on the others it slopes rapidly towards the Dee valley. This castle has a very eventful history. Then there is Valle Crucis Abbey, or the Abbey of Llan Egwest, about two miles from Llangollen, on the road to Ruthin, and said to have been built in 1200. It is now in ruins, and excavations and uncoverings have lately been made which are well worth following up, and the whole history of this ancient church is worth the notice of the archæologist, whilst any person may well visit it if only to spend a pleasant time in the beautiful valley in which it is situated. Close by is the pillar of Eliseg, said to have been erected by Concenn ap Cateli in memory of his grandfather, Eliseg, whose son, Brochmail Ysgythrog, Prince of Powys, was engaged in the border wars at the close of the 16th century. Nearer the town is a more modern structure, Plas Newydd, the residence of

By the Torrent Walk, Dolgelly.

the "Maids of Llangollen," which is now kept up by the veteran General Yorke, who has added to the original treasures of the house many objects of antiquarian and modern interest. And still again there is Chirk Castle, reached from Llangollen by a comfortable sail in the canal barge, by a charming drive on the Holyhead road, by a somewhat toilsome but beautiful walk over the hills, or by railway; and here will be found a magnificent picture gallery and other apartments, open to visitors on certain days, containing many reminiscences of the time of Charles I. and the Commonwealth, and in the park, which is of great extent and with many fine trees, is to be seen a part of Offa's Dyke.

Wynnstay, the seat of Sir Watkin Wynn, is situated in a park near Ruabon, in which are avenues of magnificent forest trees, and on its borders enchanting woods and dells. Ruthin Castle, about thirteen miles off, may also be mentioned. Llangollen, Llantysilio, and other churches, and several other places, are worth visiting.

But it is not only that the neighbourhood of Llangollen is interesting in itself, it is a centre from which other places worthy of note by the scientific student may be visited; in fact, the whole of the route from it right away through Corwen, Bala, and Dolgelly to the mouth of the Mawddwy at Barmouth is one grand arena for scientific field work. Those interested in river systems can study Bala lake and its numerous tributaries; and the sources of the Dee, the mountain ranges with eminences of considerable altitude, including Cader Idris, easily reached from Dolgelly or Barmouth, can give to those who study mountaineering many features of peculiar interest. Those who take pleasure in mining operations will find some-

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thing to employ their time in visiting the now famous gold mines of Mr. Morgan, near Dolgelly, and many other mines in the neighbourhood.

Everywhere there are some glorious bits of scenery, each differing from the other in well-marked aspects. One view we give is a part of the mountain stream near the "Torrent Walk" at Dolgelly—a most lovely spot where rocks and river and trees and shrubs and lowly plants are mingled in endless charming variety. And we must not forget to mention a magnificent drive or walk, as far as scenery is concerned, between Dolgelly and Barmouth, which should keep the scientific student constantly on the look out for the causes which have brought about such a glorious assemblage of natural features. The flora hereabout is varied and extensive. In a little work, written by Mr. James Kynock, Talydon, Barmouth, we find that no less than 500 plants have been tabulated as growing in this locality. Altogether Llangollen, and the district between it and the sea at Barmouth, afford ground for scientific field work which few localities in this country give.

Our Queen is this month to visit North Wales, and will pass through some part of the district we have written about. She cannot fail to be impressed with its great beauty. We wish her a pleasant and happy sojourn in this lovely neighbourhood, to which we know her Welsh subjects will give her a right loyal and enthusiastic welcome.

A. N. T.

The Physiography and Origin of the American Lakes.

PROFESSOR J. W. SPENCER, now State Geologist of Georgia, has been continuing his investigations, commenced ten years ago, into the physiography and origin of the great American Lakes. He has been assisted in the field-work by Professors Clendenin and Spillman, and arrived at the conclusion that the North American Continent was at least 1,200 feet higher when the submerged channels to be found near the coast were formed than it is now. The Valley of the Lakes is bounded by high escarpments upon its southern or right side, some of which are now submerged.

The glaciation of the country varies from 15 to 90 degrees from the trend of these bounding walls, and radiates more or less from the western and southern ends of the lakes. The vertical faces of the escarpments, often of a considerable height, are not glaciated as are the walls of Alpine valleys, and Professor Spencer considers this one proof that the old valleys were not fashioned by glaciers. He considers that the modern separated valleys of the lakes are the representatives of the ancient valley of the St. Lawrence and its tributaries, whose appearance has been changed by drift deposits, which in some cases has contributed to the formation of the barriers between the different lakes. But the rocky boundaries of the basins which retain the waters of the lakes have been mostly lifted up since the time of the formation of the upper boulder clay, as the lakes are all posterior to that epoch.

These conclusions are proved by the fact that the high level beaches of their former expanded waters rest upon such deposits, and that these beaches rise towards the north and east. There is but little unequal continental elevation at the western end of Lake Erie—about 2 feet per mile at the eastern end, and 5 feet per mile at the outlet of Lake Ontario, the direction of which is to the north. In some of the higher beaches there is a still greater differential elevation. Professor Spencer's researches lead him to the conclusion, contrary to the views of many American geologists, that there is no evidence of the former existence of an ice cap sufficient to dam back the lakes, and that the facts here briefly stated tend to show that the lakes are due to ordinary atmospheric erosion during a former greater continental elevation, followed by subsidence and the deposition of the drift, and finally by a differential vertical movement, as shown in the varying grades of the lake beaches, which at the time of their formation were level. T. M. R.

On the Production of Ammonia.*

By Ludwig Mond, F.I.C., F.C.S.

AFTER alluding to remarks he made at the inaugural meeting of the Society in 1881, Mr. Mond proceeded to give an account of the work he has been engaged in for many years in relation to obtaining new and abundant supplies of ammonia, and to investigations connected therewith. He referred to the great value of ammonia as manure, more particularly for the old world, which now imports from South America 650,000 tons of nitrate of soda, a substitute for ammonia, representing a value of £6,500,000, and to the immense importance of saving this expenditure by securing this commodity from resources at our own command.

Referring briefly to the processes in use and proposed for producing ammonia, Mr. Mond then described his own researches for obtaining this product from the nitrogen of the atmosphere, which, after trying a great many different methods, he found possible by improving a process invented by M M. Sourdeval and Margueritte, which consists in heating a mixture of carbonate of barium and carbon in the presence of nitrogen, thereby producing cyanide of barium. This being treated with steam yields Ammonia, and regenerates the carbonate of barium employed.

In consequence of the difficulty of finding retorts which would last at the high temperature required, this process was not persevered in, particularly as Mr. Mond had in the meantime found that it was possible to obtain a very large supply of ammonia from the immense store of nitrogen in our coal, at a reasonable cost.

Mr. Mond proceeded to describe in detail the process he has adopted and the plant he uses for obtaining ammonia from coal, which is burnt by means of a mixture of air and steam in gas producers. The ammonia is recovered from the gas by absorbing it in scrubbers with sulphuric acid. By subsequently washing the gas in another scrubber with water, which becomes heated by the steam contained in the gas, and using the hot water so obtained in another scrubber for warming the air used in the producers, and saturating it at a temperature of 76 C with moisture, Mr. Mond has succeeded in recovering the greater part of the steam required for this process; and thus, to render it more economical, Mr. Mond obtains for every ton of fuel burnt in the producers gas and tar equivalent in heating power to 80 per cent. of the fuel used, and, in addition, 70 lbs. of sulphate of ammonia, which can thus be produced on a large scale at a cost of about £5 per ton, exclusive of maintenance and depreciation, and which at present fetches £12 per ton in the market. Mr. Mond does, however, not think that this process is suitable for small consumers of fuel. The total quantity of sulphate of ammonia which could in this way be obtained from the 150,000,000 tons of coal annually consumed in the United Kingdom would be 5,000,000 tons, so that it would suffice to treat one-tenth of our total consumption of fuel to produce the 500,000 tons of ammonia required to replace the whole of the nitrate of soda now imported into Europe.

Mr. Mond subsequently described a gas battery invented by himself and Dr. Carl Langer, which has been designed to produce electricity direct from the gases made by his producers, and a new process for converting the carbonic oxide and carbo-hydrides contained in these gases into their equivalent of hydrogen, by passing them, together with steam, over metallic nickel or cobalt at a moderate temperature, so as to make them suitable for use in the gas battery. This battery, called "dry gas battery," consists of diaphragms of a porous material impregnated with sulphuric acid, and covered on both sides with very thin perforated platinum leaf and a thin film of platinum black, which are connected to the poles of the battery by suitable conductors, and are exposed on one side to gases containing hydrogen, and

*Abstract of Presidential Address to the Society of Chemical Industry, delivered at Royal Institution, London, July 10th, 1889.

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on the other to atmospheric air. In this way an electric current is set up.

The hydrogen is oxidised to water, and fully half the energy it can yield is converted into electricity. This is an immense increase upon the best results obtained by steam engines and dynamos, which do not utilise more than 8 per cent. of the energy in the fuel employed.

Mr. Mond concluded his address, which was illustrated by models, diagrams, and the gas battery in full work, by remarking that the saying "necessity is the mother of invention" no longer holds good in our days, when, by the progress of science, we are enabled to foresee and forestall our wants, but that it may truly be said that "steady methodical research is the father of industrial progress."

Notes in Brief.

A CORRESPONDENT of the *Manchester City News* raises a protest against "the stupid and silly affair called the 'Battle of Flowers,'" which lately took place at Blackpool, and which has been enacted at other places. We thoroughly sympathise with this protest, as there could not be a more pitiful desecration of some of nature's most lovely products. To anyone possessing the slightest appreciation of the beautiful, the spectacle of dusty roads strewn with the despoiled and broken blossoms of the mimic fray, together with the tossing hither and thither of bouquets of rich-scented floral gems amongst a crowd of noisy sightseers, must have suggested reflections, not of the most pleasing character, in respect to our boasted natural culture and artistic attainments. No one who has any regard for flowers could feel delight in witnessing their wilful and wanton destruction.

AT a largely-attended meeting held at the Mansion House, London, under the auspices of the Society for the Prevention of Hydrophobia, on 1st July, the Lord Mayor presiding, letters were read from the Prince of Wales, Professor Huxley, and M. Pasteur in support of the objects of the meeting. Resolutions were carried in favour of a fund being established to make a suitable donation to the Pasteur Institute in Paris, and to provide for the expenses of British subjects, bitten by rabid animals, who were unable to defray the cost of a journey to Paris. The Government were also invited to introduce, without delay, a bill for the simultaneous muzzling of dogs throughout the British Isles.

EDISON'S phonograph has not been long in making its way as an instrument of practical utility. A certain auctioneer is said to use it for the purpose of repeating the conditions of sale. Diplomatic correspondence by phonograph has lately been inaugurated between the Italian Chargé d'Affaires in London and the Italian premier, Signor Crispi, who forwarded the following message in reply:—"A voice coming to me through such a medium, and emanating from powerful and enlightened England, tells me that human progress knows no limits, but belongs alike to all nations when mindful more of their common origin than of past conflicts."

AMERICAN enterprise is certainly not half-hearted. What is probably the most exhaustive photographic enterprise ever attempted has just been successfully completed in New York. Mr. Wallace Bruce has had every yard on the banks of the Hudson River photographed from mid-stream between New York and Albany. Altogether there were 800 negatives, from which photo-engravings were made, and they are now published in a book, the shores arranged on each side, and the river in the centre of the volume. In this manner has been formed a most complete and realistic guide-book of the interesting country of Hendrik Hudson and Rip Van Winkle. Even the enthusiastic lovers of the Thames have not yet achieved anything like that.

IT is stated that a committee of the Anthropological Institute has been formed for the purpose of advising barrow openers and other archæological explorers. General Pitt-Rivers, the official Inspector of Ancient Monuments, finds that a great deal of irreparable damage has been done by unskilled explorers, who have neglected that accurate examination of the exhumed relics which is demanded by modern science, this neglect being especially notable with regard to the measurements of human skeletons and animal remains. At his instance a standing committee of aid has been appointed, and a schedule of instructions for explorers will, in due course, be drawn up.

SO Snowdon has been sold! The price paid for the property at a recent auction, £5,750, cannot be said to be exorbitant, considering the unique character of the estate, which was described as "consisting of mountainous land, including the summit of the world-renowned Snowdon, with its hotel and beacon." The mineral wealth of the estate comprises over 1,500 acres, rich in copper, slate, and other minerals, which have never yet been thoroughly developed.

LADY visitors to Yorkshire, who desire some little variety in the usual routine of sea-side life, may endeavour to emulate the achievements of two ladies who have shown great courage this year in helping to gather the harvest of eggs on the cliffs at Bempton and Speeton, near Flamborough Head. They were very carefully lowered from the summit, and there was really little peril; but, all the same, the look down the sheer face of a cliff over four hundred feet high requires nerve and confidence in the material of which ropes are made.

THE Annual Conference of the Library Association will be held in London during the second week in September. The Masters of the Bench of Gray's Inn have placed their hall once more at the disposal of the Association.

A PLEASING ceremony recently took place at the Free Library, Liverpool, when the past and present members of the staff assembled for the purpose of presenting to the chief librarian, Mr. Peter Cowell, a souvenir on the celebration of his silver wedding, as a slight mark of their esteem and good wishes on so memorable an occasion. The gift took the form of a handsome cabinet, comprising a liqueur stand and set of games, and bore a suitable inscription. The presentation was made in appropriate terms by Mr. T. Formby, sub-librarian, and supported by Mr. J. Collister and Mr. Walter Huntly.

SOME interesting tests have lately been made at Dartford with carbo-dynamite, a new explosive, the novel feature of which is the use of a specially-prepared carbon capable of absorbing 15 per cent. more nitro-glycerine than there is contained in ordinary dynamite. A series of 12 tests showed that the work done by the new substance was equal to that achieved by blasting-gelatine under similar conditions. Water does not interfere in any way with the explosive properties of carbo-dynamite.

ALTHOUGH the Miners' Conference has passed a resolution condemning the use of roburite as an explosive in mines, some eminent practical authorities amongst mining engineers consider that this substance is an actual advantage to those engaged in the working of collieries. Mr. Henry Bramall, M.Inst.C.E., has specially investigated the effects of roburite on the workpeople who are brought in contact with it, and he attributes the ill effects noticed to the generation of carbonic oxide gas from the explosion of the compound. Workmen should on no account be allowed to breathe the fumes which are given off, or to return to their work until all the fumes have passed away. If this precaution be taken, the use of roburite becomes practically safe.

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A POINT of some interest to chemists is suggested by Mr. Bramall. Roburite is said to contain amongst its constituents one part of di-nitrobenzene, a portion of which, when the explosion is not perfect, becomes vapourised, and, if inhaled, would combine with the blood to form aniline with resultant poisonous effects.

PROFESSOR LEWIS SMITH, of the Warner Observatory, Rochester, New York, discovered a comet on the 6th inst., in R.A., 22h., 52m. 30s. (decreasing 2 minutes daily). North Polar distance 89 deg. 11 min. (increasing 10 minutes daily). This is the fourth comet discovered this year.

IN the hitherto unexplored regions of Northern Mexico, Lieut. Schwatka has discovered a large tribe of cave-dwellers, who still live after the manner of the men of the Stone Age. The people are wild and timid, and fly to their holes in the rocks on the approach of white people. They climb like monkeys, and are said to be sun-worshippers.

ASTRONOMICAL photography seems still to be progressing in its useful function. Professor Pickering, Director of the Harvard College Observatory, has issued a circular containing the pleasant announcement that Miss C. W. Bruce, of New York, has presented 50,000 dollars to the University, for the purpose of establishing an observatory on one of the mountains of South California, with a telescope having an object glass 24 in. in diameter, for photographing the stars. With such an instrument it is considered that a photograph of three quarters of the entire sky could be secured on about 1,200 plates in about two years. The instrument is to be christened the "Bruce Photographic Telescope."

AT the Cape Observatory, Dr. Gill has done much for photographing southern skies, chiefly by the expenditure of his own money and a grant from the Royal Society, but his American colleague will have the better chance now unless some South African millionaire will give him the opportunity also of sending a 24-inch telescope to the mountains.

ASTRONOMERS are again exercised about sun spots. Mr. Elliot, in his last meteorological report for India, says:—"So far as India is concerned it would appear that it is the period of minimum sun spots, which is associated with the largest and most abnormal variations of meteorological conditions and actions." The most disastrous famines of recent years in India have occurred near the period of minimum sun spots. As we are now passing through the same phase of the sun spot period, it is interesting to inquire whether there are any abnormal variations common to the present minimum period of sun spots, and the previous corresponding periods of 1865-6 and 1876-7.

A RIVAL to the Colorado beetle has appeared, in the shape of a bluish-green insect, which is the cause of great loss to the wheat growers of Illinois. The pests appear by hundreds. Its abundance is attributed to droughts and early spring of this year.

IN our own country the feature of the present year is the havoc played by "grubs" in some of the finest gardens and orchards. Apple trees have been affected much in the way related by Mr. Fish in his recent article on "Economic Entomology" in our columns.

HOW long will a tortoise live? Professor Flower recently exhibited the tortoise of Archbishop Laud, which he brought to Lambeth when he became Archbishop, and which lived 130 years. Another specimen of this animal at Peterborough was known to be over 180 years old when it died.

M. ARMAND GAUTIER, well known for his researches on the alkaloids, has been elected member of the Chemical Section of the Paris Academy of Sciences, in succession to the late M. Chevreul.

MISS SOPHIE STURGE has settled down at Letterfrack, in Connemara, to teach a new industry. Eighteen months ago, when travelling through the district, she was struck with the poverty of the people, and determined to do something for them. Returning home she got a thorough training in England in basket-making. She then went to France, where she learned how to make pretty French baskets; in the following summer she settled down in Letterfrack and started teaching the trade of basket-making. She began by teaching one small boy, but her class rapidly increased, and there is now quite a little industry established there.

AT the recent examination at the Manchester Technical School, Cyrus Ainsworth, the holder of the £50 exhibition given by the late Alderman Goldschmidt, tenable at the Royal College of Science, Dublin, has succeeded in winning the first of the two Royal Scholarships offered by the Science and Art Department, each of the value of £50 for two years, together with free tuition. James P. Wrapson, the holder of the exhibition given by Mr. Oliver Heywood, has just completed his three years' course. He stands at the head of the list, having the first place in five subjects, and the second in the other two, winning £7 in prizes.

THE Pope has decided, at the instance of Father Denza, director of the Observatory at Moncalieri, that an astronomical observatory should be erected at the Vatican, the place selected for it being the tower surmounting the apartments of the President of the Sacred College, which is the highest of the buildings in the Vatican.

A PROPOSAL is on foot to run a light line of railway to the top of Ben Nevis. Starting from a point near old Inverlochy Castle, the line would follow, as near as possible, the existing pony track.

SIMULTANEOUSLY with enormous swarms of locusts, a very remarkable bird has invaded the Valley of Sofia. Its scientific name is *Pastor roseus*. The aspect of the bird is uncanny. The plumage of the head, the neck, the wings, and the tail are black, with a greenish-metallic gloss; the feathers on the belly and back are white, with a yellowish-russet admixture. The length of the body, from the beak to the end of the tail, is about eight and a half to nine inches. These birds destroy a large number of locusts, for which reason they are now placed under official and general protection, the same as the storks and swallows.

THE Lymm Water Works Company has commenced to sink another well close to the first boring. It will be sunk to a depth of 300 feet, or 100 feet below the one constructed last year. The well is being sunk to hold in reserve in the event of the possibility of a mishap. The work is being performed by Messrs. E. Timmins and Sons, of Runcorn.

MR. CARUS-WILSON has devised an effective dry method for separating the denser minerals from sand. A piece of cardboard about two feet long is bent in the form of a shoot or trough, and held in this form by elastic bands at either end; this is then held at an angle sufficiently inclined to allow the sand to travel slowly down the shoot on being gently tapped. A small quantity of the sand to be treated is now placed at the head of the trough. When the trough is tapped the sand travels slowly down, and in doing so the denser grains lag behind, forming a dark mass in the rear of the stream. When a sufficient quantity of this denser sand has been collected, it should be placed in the lid of the cardboard box, and gently shaken to and fro at a slightly-inclined angle, the mass being at the same time gently blown upon with the breath. The finer quartz grains will thus be blown away, and hardly any but the denser grains will remain.

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THE sands covering the north-west extremity of the Bell Mountain, or Jebel Nagous, situated on the Gulf of Suez, about four and a half hours' journey from Tor, emit a musical sound when agitated by the wind or by the steps of man. The mountain, which is about three miles long, is 1,200 feet high. The sand is of a yellow colour and is curiously mobile, and when disturbed the note it gives out resembles the bass of an organ. The volume of sound of course depends on the quantity of sand in motion. Mr. Bolton has discovered that the phenomenon is by no means unique in the desert of Sinai. There is another Nagous in the Wadi Werdan, about five minutes' walk from the caravan trail. It is called Ramadan by the Bedaween, and forms the end of a chain of hills about a quarter of a mile long. The sand upon it produces the same low note as the Jebel Nagous, but not so strongly.

THE new Queen's Bath in Bath city, erected by the corporation at a cost of £25,000, has been opened by the Duchess of Albany. The building is Roman in style, and has been built from designs and plans by Major Davis, F.S.A., the city architect.

ACCORDING to the *American Monthly Microscopical Journal*, the use of photography is recommended by Mr. Geo. G. Rockwood, of 17, Union Square, New York, as an accessory to the microscope in detecting alterations in manuscripts, &c. He has for years been in the habit of photographing manuscripts, models, books of account, cheques, and drafts, whenever their genuineness was questioned. The process sometimes makes legible figures, amendments, and alterations which even the microscope does not fully bring out. This is due to the extreme sensitiveness of photographic plates to shades of colour. With the new "autho-chromatic" or colour-sensitive plates almost imperceptible stains on old, yellow paper have been made clear and legible.

MR. WILLIAM GREEN, of Berwick-on-Tweed, has issued an admirable series of photographs of wild birds, their nests, eggs, and breeding places, all taken strictly from nature, without alteration or arrangement of any kind. The series includes views of the Farne Islands, the Bass Rock, May Island, St. Abb's Head, and the haunts of the golden eagle on Benmore in the Highlands. Guillemots, kittiwakes, gulls, eider ducks, terns, cormorants, and gannets are photographed in some of the most picturesque places on the coast. All the photographs are beautiful specimens of the art, and should prove of great value to students of natural history.

CIVIL LIST PENSIONS.—A list of Civil List pensions granted during the year ended the 20th June last has been issued. From this it appears that a pension of £200 has been granted to Mrs. Helen Patey in consideration of the services rendered by her late husband, Mr. C. H. B. Patey, in the improvement of the telegraph services of the country, and a pension of £100 to Mrs. Sallie Duffield Proctor in consideration of the service rendered to the cause of science by her late husband, Mr. R. A. Proctor. Pensions of £75 have been granted to each of the following:—Miss Evelyn Lucy and Miss Jane Hewett, in consideration of the distinguished naval services of their late father, Admiral Sir W. N. W. Hewett; Mrs. Sophie Watts, in recognition of the services of her late husband, Mr. Henry Watts, to chemistry; and Mrs. Elizabeth Sowerby, in consideration of the botanical works of her late husband. To the following pensions of £50 have been granted:—Mrs. Katherine Palgrave, in consideration of the literary services of her late husband, and of his long service in trying climates; Mrs. Blanche Gertrude Guthrie, in consideration of the eminence of her late husband, Professor F. Guthrie, as a physicist; Miss Emily Faithfull, in consideration of her services as a writer and worker on behalf of the emigration, education, and employment of women; Mr. William Smyth Rockstro, in consideration of his services to musical literature; Mrs. Eliza Shairp, in recognition of the services rendered by her late husband, Professor Shairp, to literature; Mrs. Maria Jane Graves, in consideration of the services of her late husband, the Rev. James Graves, to archæology and to the early history of Ireland; Dr. C. A. M. Fennell, in consideration of his eminence as a classical and philological scholar; Miss Elizabeth Gertrude and Miss Juliana Frances Birch, in consideration of the services of their late father, Dr. S. Birch, as an archæologist; Mr. W. Cave Thomas, on account of his personal service to the Royal Family, and in consideration of his services to art; Mrs. Margaret Rainey Porter, in recognition of the services of her late husband, Dr. J. L. Porter, to education and literature; and Dr. James Hutcheson Stirling, in recognition of his services to philosophy and literature.

Museum Notes.

AMONGST recent museum appointments we may notice that of Mr. Henry Crowther (late assistant-curator of the Leeds Museum) to the curatorship of the museum at Truro, Cornwall.

THE eleventh anniversary of the opening of the Nottingham Castle Museum and Art Gallery was celebrated last month. Over 50,000 pictures and other works of art have been received and returned, and 29 special exhibitions of pictures, paintings on porcelain, &c., have been held. In 1885 the committee decided to make the admission free on Tuesdays. This proved so great a success that last year Thursday was made a free day. The number of visitors on free days since 1885 has exceeded 330,000.

AT Peel Park, Manchester, the Exhibition of Photography has been very successful. During Whit-week the curator reports that no fewer than 57,100 persons attended the exhibition at the Museum.

As we anticipated in an early number, the committee of the Grosvenor Museum, Chester, have found it necessary to increase their accommodation in consequence of the demands upon the resources of the institution, and they have accordingly decided to carry out an important extension scheme. The enlarged museum will provide new and better accommodation for the Archæological Society and for the Natural History collections, as well as for new class-rooms for art. The Duke of Westminster has approved the extension, and the work will commence forthwith. The style of architecture will be in accordance with the rest of the building, which was designed by Mr. T. M. Lockwood.

THE first number has been issued of a catalogue by Professor J. Wood Mason, describing new genera and species, and an enumeration of the collection in the Indian Museum, Calcutta.

THE report annually presented to the House of Commons on the progress of the British Museum is always an interesting document, and the Parliamentary paper just issued contains many details of a satisfactory character as showing the steady advance of the national library and its allied departments. Last year the visitors to the general collection at Bloomsbury numbered 498,510, whilst there were in addition 372,802 visitors to the Natural History Museum in Cromwell Road. At the Reading Room the attendance has increased so much that precautions have had to be taken against overcrowding, and some effort has been made to weed out those who are not genuine students. In the catalogue department 64,577 title slips have been prepared for the printer. Many rare books relating to the East have been secured, including several valuable MSS., Homeric papyri, and tablet books. Specially important are the selections of coins of India, made from Sir Alexander Cunningham's collections.

THE Commercial Museum of Buda-Pesth is about to establish a Bosnian section in its permanent exhibition in the Bois-de-Ville, as well as a branch at Serajero, with the object of promoting the exchange of samples of the products of the Bosnian soil and articles manufactured in Hungary.

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SIR PHILIP CUNLIFFE OWEN, Director of the South Kensington Museum, calls attention in his Report to the Department to the increase in the number of visitors to the Museum over that of the preceding year, which he ascribes not to any special or permanent attraction, but as a sign of reviving interest in this and similar institutions accompanying the revival of trade and industry.

FROM the Thirty-sixth Annual Report of the Department of Science and Art of the Committee of Council on Education we gather many interesting statistics and encouraging results of work at the various state museums of the country. At South Kensington numerous important acquisitions have been made, including a series of radiometers and tubes for demonstrating electrical phenomena in high vacua, used by Mr. W. Crookes; a fine series of 300 coloured sketches of sunsets observed at Chelsea during 1883-6, by Mr. W. Ashcroft; and a set of Sir Wm. Thomson's standard electrical instruments. It is gratifying to learn that the collections continue to be largely used by classes and their teachers, 1,687 students having been afforded facilities during the year for examining and handling apparatus. But circulating collections of science apparatus have been issued to only 87 classes, which does not show sufficient appreciation of the value of these collections. Some additions to these collections have been made, especially under the heads of geology and physiography.

THE Director of the Edinburgh Museum of Science reports that the construction of the building, commenced in 1860, has now been completed. Several improvements in the arrangement of the collections can now be effected, and certainly is desirable. Dr. R. H. Traquair, keeper, states that he has been enabled to resume the arrangement of the general collection of insects, which long laid in abeyance. Amongst the donations made to the Natural History Department are included 640 skins of birds, from the Trustees of the British Museum, and a number of skins of fishes collected by the late Dr. Parnell. Of the purchases, the most important is the skeleton of the great auk *(Alca impennis)*, constructed from bones found at Funk Island, off Newfoundland. A collection of British bird skins, formed by the late Mr. Robert Gray, lately acquired, forms a valuable nucleus for the future development of a proper series of skins illustrative of British ornithology. Consequent on the death of Mr. Gibson and the retirement of Mr. Stock, Messrs. W. Eagle Clarke and F. G. Bainbridge have received appointments on the staff of the Museum.

NOWADAYS, when every body of workers is represented by an association or congress of its own, there is no reason why curators and those engaged in the active work of museums should not also combine together for the advancement of their own needs. Such co-operation, it may be expected, will increase their opportunities for mutual assistance, and lead to an interchange of ideas and diffusion of knowledge amongst themselves which will be highly advantageous. Amongst the objects of the new Association of Museums the following are set forth in a circular issued by the representatives of some of the most important musuems in the north of England:—The adoption of the best methods of classification and disuse of obsolete systems; the interchange of duplicate specimens; concerted action for securing Government publications; the indexing of the contents of museums and the publication of a journal. It will be apparent that there is sufficient scope for the new body to work upon, and its operations are likely to be more successful under independent management than simply as a tag to some other institution, as was attempted at the late National Art Congress.

THE appointment of the Rev. H. H. Higgins, M.A., of Liverpool, to fulfil the inaugural duties which will devolve upon the first president of the new association, has given much satisfaction. It is not only regarded as an honour to the city and to the institution, which has grown up under his fostering care, but is a testimony to the general appreciation which has been accorded to Mr. Higgins' successful endeavours in the spreading of scientific knowledge amongst the people. Few persons have voluntarily done so much to promote the important educational functions of museums, as instanced by his series of handbooks and museum guides, and by the travelling museum-boxes which have proved so serviceable to the schools.

PROFESSOR V. BALL, F.R.S., Director of the Science and Art Museum, Dublin, in his customary annual report, states that the most noteworthy work accomplished in the Natural History Department has been the alteration of the mammal cases and the introduction of side lighting in the principal gallery. It is intended to devote the top gallery to the entomological collections, and to prepare a collection of specimens illustrative of the geographical distribution of animals. The palæontological collections at Dublin include Sir Leopold McClintock's unique Arctic collections, Sir Richard Griffith's carboniferous fossils, and a large series of Sivalik vertebrates. An instructive addition is about to be made in the preparation of a relief map of Ireland, coloured geologically as groundwork, with indications of archæological sites and other matters of interest, which are desirable to be represented in a bird's-eye view.

IN order to stimulate Netherland exports to Switzerland a Dutch Commercial Museum has been established at Zurich, and to this institution are affiliated members of the most important industrial and commercial houses of the Netherlands; and colonial as well as manufactured articles can be procured directly from the Netherlands through the museum.

SUNDERLAND MUSEUM.—At a recent meeting of the Museum and Library Committee Mr. Cameron read a letter from the Rev. H. H. Higgins, of Liverpool, who lately visited Sunderland. He said:—

"My visit to Sunderland was altogether most gratifying; the astonishing conformations exhibited by the rocks at Roker Bay, the beautifully-planned and kept parks, free to the people, and the Museum, with its kindred institutions, were alike unanticipated by me, and, when realised, constituted a charming surprise. The rocks, if not so grandly picturesque as Staffa and the Causeway, are in the scientific interest of their formation quite worthy of a place in the same series, and photographs of them would be a most acceptable contribution to Section C., British Association, Newcastle. The Sunderland Museum is admirable. Its plan recognises as of primary importance the full illustration of objects of natural science, for which the locality is remarkable. This being cared for, typical groups or alliances have been established, especially in birds, exhibiting instructive and attractive features in Nature's great kingdom of life, such as order, beauty, geographical distribution, economic value, the comparison of the form of an object with its life-history and habits. All this must be associated with conspicuous and explanatory labels, which are the voice of a museum. Specimens which are mere curiosities, adding nothing to instructiveness or beauty of the collection, should be carefully excluded—a requirement often involving great difficulty. Specimens not interesting to the public, or capable of being made so—such as objects of microscopic size, and series of species differing inconspicuously—should as far as possible be kept in drawers for the use of students, to save exhibition space. The excellence of the Sunderland Museum is due in great measure to its having been intelligently formed for the instruction of the people—not contributed mainly on the gift of a private collection, or the collectanea of a society. Such an origin involves a considerable expense, but the advantages of the method are worthy the outlay. Many fields are yet with you unrepresented, the choice of which for immediate attention may be left to taste and opportunity; but the promise of the Museum is so good that the means of carrying out such a work will doubtless with readiness be forthcoming. You ask for a suggestion—Carry out your system of labels, adding a few more comprehensive indicators in larger type. If you can supply your Board schools with small cabinets of good specimens for circulation, the voluntary schools will soon wish for them. With hearty good wishes for the success of your work, I am, yours, "HENRY H. HIGGINS."

Recovery of the Remains of the Ancient Chantry Chapel of St. Michael, at Garston.

BY EDWD. W. COX.

DURING the autumn of 1888, the small Church of Garston, which was erected in 1715, by Edward Norris, of Speke, was taken down. It is recorded in Bishop Gastrell's *Notitia*, made about 1825, that this structure occupied the site of a larger and more ancient one. On the removal of this later church, it was found that the ruins of the older one had been used to make foundations and a kind of platform, many feet deep, for the newer structure. The stones were carefully buried in earth without being destroyed, and sufficient details remained to show the structure of the original building, and to recover its plan and style. The Abbey of Whalley held large possessions in Garston, the titles to which are given fully in the *Chartulary* of Whalley, still

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existing. After the Reformation it was chiefly in possession of the Norrises, of Speke, and was the chapel and mortuary of the Norrises. The remains prove that this powerful and once wealthy family gave their chapel the style and proportions of a large and important church. At the dissolution of the Chantries, in the reign of Edward VI., Garston Chapel possessed one vestment, one silver gilt chalice, and a paten. The endowment for the one priest was then confiscated, and Bishop Gastrell says that no service had been held in it since the Reformation, and that in 1650 it was ruinous. There is, however, evidence in these remains of later repairs, and there is reason to believe that as some members of the Norris family held the older faith down to the time of the Civil War, this chapel was used and partially repaired for service.

THE CHANTRY CHAPEL OF GARSTON.
As restored from remains recently found.

The remains show that the chapel had a tower surmounted by battlements and belfry windows, with uncusped tracery, four plain gargoyles, one on each face, and probably a three-light west window, and that it opened into the church on the east side with an arch. The style of this structure seems to be that of the early part of the 14th century, and fragments of all these details were found, and a sufficient number of the battlements to give a clue to the size of the tower. The nave was divided into a centre and two side aisles by a range of three arches supported by octagonal pillars, and the chancel also had three arches on each side, the southern chancel aisle being of more importance, and forming, it is believed, the Norris Chapel. Nearly all the capitals were found, and the difference in the mouldings enabled those from the nave and chancel to be distinguished. The nave had a clerestory with a battlemented parapet. The windows in the church were apparently all square headed, even the east window, of five boldly trefoiled lights, but those of the Norris Chapel were probably pointed and richly moulded with late tracery. The chancel arch, of which a fair number of stones were recovered, was elaborately decorated with interlacing panel tracery, and this, with the Norris Chapel, was of fine white stone, the rest of the church being of grey and red stone. The body and chancel appeared to be late in the 15th or early in the 16th century. The roofs were apparently low pitched, this being apparent from certain coping and gutter stones, which indicated the angle of their springing. A stone bearing date 1607, which had evidently belonged to the church, and had been built into the churchyard wall, indicated later repairs, as did some other features. In the churchyard still stands the base of the ancient cross, scooped out into a kind of basin in the manner of similar crosses called "plague stones," the object being to exchange money for goods by depositing it in vinegar in the hollow stone, thus avoiding the meeting of vendor and buyer in times of plague. The village cross, removed some years ago, is also laudably preserved by Mr. Owen, stonemason, in his yard.

It is desirable that a small sum of money should be raised in order that during the levelling of the churchyard provision may be made for the classification and preservation of these interesting relics, and for the careful search of the site before closing it. It is supposed that the tombs of some of the ancient and honourable family of Norris may be found under the *debris*, and, though the family is now extinct, Liverpool owes them regard as being instrumental in the construction of its first docks. Many of the relics have unhappily been destroyed, contrary to the wish of the Incumbent and others who have endeavoured to save them, and it is hoped that early assistance will be given to preserve what remain.

Foxcovers, Bebington.

Flower Names.

AMONGST other features distinctive of the modern novel, none indicates more clearly the increased culture of to-day than the constant use of the scientific names of the flowers. Even with a writer so free from pedantry as the late Charles Kingsley, the wild Canterbury bells become "tall blue campanulas," while the finished grace of Ouida's style admits no term for the dainty little wood-sorrel so frequently as that of "the pearly oxalis." Even into milliners' fashion plates the custom is creeping, and mignonette greens are now dubbed "réséda," though this fact may be due to Parisian influence as much as any. And the phenomenon is not without its sorrowful aspect. With the advent of *digitalis* as the sobriquet of the fox-glove—that flower which so long has been the "wee folks'" special property—vanish many of the tenderest associations of our childhood. And since *polypodium* and *osmunda* became nursery names, we fear that the very fern seed is losing its invisible quality. A word no longer conjures up a troop of Robin Goodfellows dancing in fairy rings round the mushrooms, or seated astride toadstools, bringing elfin music out of the harebells, or winding in and out through tiny heather forests.

Who cares to steal a kiss at Yule-tide beneath a bough of *viscum album?* The sacred white berries are ever the same, but the word that made the charm is gone. Once upon a time our hearts warmed within us at the sight of poor lonely Jack-by-the-hedge, or sauce-all-alone, as he was sometimes called. How the neglected independence of the ancient herb smote us with pity, though so useful a gentleman could be no mere beggar suing for alms. But, alas! sentiment departs when our old friend becomes known to us as *alliaria officinalis!*

Some of the names we protest that we never shall drop, and amongst them forget-me-not and woodruff. Nevertheless, already *myosotis* is more used than the quaint farewell of song and legend; and though *asperula odorata* is not yet general, no doubt the time is at hand when it too shall be colloquial, having deposed that more lovable, if less dignified, word, to which cling as many memories for some of us as might be hidden in a *pot-pourri* jar. "Fair daffodils"—sang Herrick to the golden wind-flowers—"we weep to see you waste away so soon." Alas! the very meaning of his song makes haste to go. *Narcissus pseudo narcissus* will soon have driven out the grand old English name for our frail Lent lilies. And who, then, will remember the pale *narcissus poeticus* as the primrose o' paradise that our Yorkshire country folk have loved to call it?

Soon half the meaning of the little wild fumitory—earth-smoke—will be lost, for we shall have fallen into the new-fangled habit of saying *fumaria*. But this, after all, is the prejudice of the old against true progress, for it must never be forgotten that *veronica* marks a distinct advance on speedwell, *stellaria* on stitchwort, and *taraxacum* on dandelion.

In the first place the dead are also the universal languages, and from these are the scientific names chiefly derived. *Geranium*

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pratense appeals to a much larger section of educated Europe than meadow crane's bill. *Pyrus* is a word more widely recognised than apple or pear.

And, secondly, the popular cognomens are so uncertain! The Devonshire peasantry split the mibrib of the beautiful hartstongue *(scolopendrium)*, and call it Jesus' hair fern, from the appearance of the vascular fibre thereby displayed. The common toad flax *(linaria)* is snake's food in the same county, and wild snapdragon in some others.

The flower usually known as nasturtium *(tropæolum majus)* ought really to be called Indian cress, as the true nasturtium belongs to a very different order; while anyone who has tried to identify such flowers as lady's needlework, lady's mantle, burnet, or butterwort by name only will have discovered how utterly impossible it is to do so.

It is sad to see the old names go, but go they must, for the sake of that finer adjustment of meaning and expression which is the motive of all progress in language. And, meanwhile, our English literature will preserve the folk-lore that is most endeared to English minds. As long as Ophelia remains, no one can forget that rosemary is for remembrance, and pansies for thoughts; and one of the gems of our language brings ever before us a certain

> "Bank where the wild thyme blows,
> Where oxlips and the nodding violets grow;
> All over-canopied with luscious woodbine,
> With sweet musk-roses and with eglantine."

As long as English endures Shakespere is not dead, and while that voice speaks in its perennial sweetness—not to mention Wordsworth and Herrick, Howitt and Burns—the old flower-names can never be entirely lost.

MARGARET E. NOBLE.

Wrexham.

Boulders in Coal.

ONE of the geological puzzles of the present day is to account for the presence of boulders of quartzose rock in seams of coal, the boulders varying in size from small pebbles to large blocks, weighing 100 lbs. to 200 lbs. and upwards, and often smoothed, polished, or water-worn. These are known to have occurred in carboniferous strata in Leicestershire, from which county many instances have been described by Mr. W. S. Gresley, and they have also been noticed in several coal-fields in Lancashire, Staffordshire, the Forest of Dean, and South Wales. Mr. Mark Stirrup described several Lancashire specimens to the British Association at their Manchester meeting. The presence of these boulders has been known since 1851, but they have always been considered rare, and it is only lately that they have been specially looked for. They are usually composed of hard siliceous grits or quartzites, frequently covered with a coating of carbonaceous matter. Nor does their occurrence seem to be confined to British strata. Several instances of these boulders are recorded in the memoirs of the American Survey. The great importance attaching to them is in the fact that if we could but read their history aright it would, undoubtedly, throw a clear light on the much-vexed questions surrounding the physical features of the period when the carboniferous rocks were being deposited.

Many suggestions have been hazarded and numerous theories broached to account for the presence of these foreign masses of rock deep down in seams of coal. They are evidently older than any rocks of the Carboniferous Period, but whether they are to be regarded as fragments of some ancient Cambrian or Archæan continent is still an open question. There do not appear to be any sands or clays associated with these boulders, so as to suggest transport by currents of water. Tropical torrents of great force are some of the agents which have been adduced as a means of bringing down these blocks of stone from some higher lands.

The flora of the coal measures is identical throughout thousands of feet of strata, and gives us no indication of any glacial conditions whose agency of transport might otherwise have been brought into play. No theory yet propounded is entirely satisfactory, and only a careful accumulation of facts in regard to their occurrence will enable us to unravel the mysterious history of the boulders in coal.

Our Portrait Gallery.

XIV.—CHEVREUL.

MICHEL EUGÉNE CHEVREUL, the eminent French chemist, who died in April last, at the great age of 102 years, seven months and ten days, was born at Angers on the 31st of August, 1786, and was educated at the Ecole Centrale of that city. At the age of seventeen he proceeded to Paris and entered the chemical establishment of M. Vauquelin, and, when barely twenty years of age, was given the direction of the laboratory. In 1820 Vauquelin chose him as his assistant in preparing for his lectures at the Museum of Natural History, and three years afterwards CHEVREUL was elected to the Chair of Chemistry in the Lycée Charlemagne. A few years afterwards he was appointed Director of the Dyeing Department and Professor of Special Chemistry at the Gobelins, and in this position brought to bear upon his duties great scientific knowledge, combined with earnest perseverance and desire for investigation.

In 1811 he commenced researches on fatty bodies, which were destined not only to give to the world remarkable scientific discoveries, but to largely aid in the development of important manufacturing industries. The first of his papers to the Academy of Sciences was given on the 9th of July, 1813, and had reference to the isolation of margarine, and a few months later, in 1814, he described the production of stearine and oleine. These researches, which entailed an enormous amount of work, proved him to be possessed of qualities eminently fitting him for original investigation. The researches were continued for several years, and formed the subject of many memoirs between the years 1813-24. In 1823 he published a treatise, entitled *Lès Reserches Chimiques sur les corps gras d'origine animale.* It is interesting to note that of these researches on fatty bodies, which have borne such excellent fruit, he himself said he was instigated to make them by having given to him one day a sample of soap to analyse, and in the examination of this he noted facts which led him to further investigation.

He was elected a member of the Academy of Sciences in 1826 in succession to Proust. In 1828-1831 appeared his *Leçons de Chimie Appliquée à la Teinture*, followed in 1839 by *De la loi du Contraste.* In 1830 he succeeded his former master, Vauquelin, in the Chair of Chemistry in the Museum of Natural History, and in 1864 was appointed Director of the Museum, a post which he held at the time of his death. In this position he

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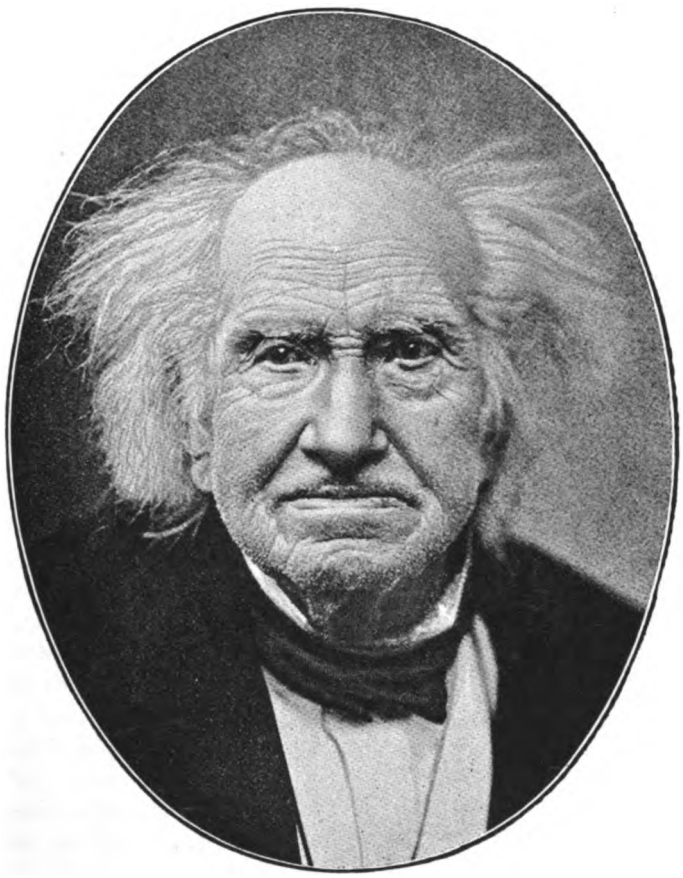

MICHEL EUGÉNE CHEVREUL.

From a Photograph by Nadar, Paris.

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displayed brilliant talents as an investigator, coupled with great industry and indomitable perseverance; and the results of his numerous researches have contributed not only to the development of scientific knowledge of fats, colours, &c., which were his special studies, although his labours were not entirely confined to these, but have had immense influence upon industrial pursuits connected with these substances, and helped much in contributing to the comforts and luxuries of ordinary life. As an instance of his devotion to his duties we may mention that in 1870, when 84 years of age, during the bombardment of Paris, although earnestly entreated to leave, he still remained at the Museum, notwithstanding that the bombardment was so fierce that no less than 85 shells fell round about his laboratory.

His investigations on the fats were soon made practically useful. CHEVREUL, having ascertained how to isolate fatty acids, thought that their properties could be utilised for improvement in candles, &c., and, acting with Gay-Lussac, he so worked that the now important manufacture of stearine candles was commenced; and the chemical reactions indicated by CHEVREUL'S researches are still the main features of this important industry, which has assumed enormous proportions, and affords a splendid example of the practical benefits that may accrue to the world from true scientific research.

It cannot but be supposed that such earnest labours have been much appreciated, and so we find that CHEVREUL was a member of many learned societies in France and other countries, including our own Royal Society, and he received the Grand Cross of the Legion of Honour and other distinctions from his own country, and many marks of approval from other nations.

Combined with his enthusiasm and love of science, he showed great simplicity of tastes and beauty of character, and certainly was one who was beloved, honoured, and respected by all who knew him. In 1886, on the occasion of his 100th birthday, he received hearty congratulations from all parts, testifying to the respect in which he was held.

Even to the later days of his life he well preserved his physical vigour and clearness of mind, although for some time before his death it was evident that his strength was failing, but to the end he evinced great interest in scientific topics. He took very great pleasure in the raising of the Eiffel Tower, and lived to see the completion of the work; but soon after returning home on the day when he saw the flag on the top announcing the finishing of the work, he was seized with faintness, and after lingering for a few days he died on Tuesday morning, April 9th.

He was a great collector of works on chemistry and alchemy, and since his death his grandchildren have presented to the Paris Natural History Museum his valuable collection of books and manuscripts—a collection of which the authorities of the museum may well be proud.

We could write very much more respecting the scientific work and excellent qualities of CHEVREUL, but our space does not allow, but of him it may be truly said that he lived a life prolonged much beyond the average, but it was a thoroughly useful life, and one the labours of which will not readily be forgotten. A. N. T.

The Evolution of the Grand Cañon of the Colorado.

A Problem in Physiographical Geology.*

BY W. HEWITT, B.Sc.

Part II.

Having thus very briefly sketched the physical conditions of the district, let me now state the chief problems which present themselves for solution:—

1. By what means have the gorges been cut and the great denudation effected?
2. Why have the upper beds of the Carboniferous series formed the lower limit to the great denudation and, consequently, the surface of the resulting platform?
3. Why is the gorge in two parts—an outer and an inner gorge?
4. At what age (geologically) was the principal erosion carried on?
5. What have been the conditions necessary for the production of the special and characteristic features of the Grand Cañon as it at present exists?

I.—By what means have the gorges been cut and the great denudation effected?

Captain Dutton quotes from Mr. Gilbert's monograph on the Henry Mountains a very interesting analysis of the principles upon which the erosive action of streams depends. This erosion is stated to be mainly performed by the aid of hard mineral fragments carried along by the current—"the effective force is that of the current; the tools are sand, mud, and boulders." And the amount of corrasion—as this process is termed—depends directly upon the proportion existing between the load of material which the river actually has to transport, and the maximum load which it is capable of carrying—the surplus energy only being available for corrasion. Now, the declivity of the Colorado is considerable, varying from 3½ to 12 and even 21 feet per mile, with an average of 7·72 feet per mile (while that of the Thames is only 1·75 feet), and, consequently, its velocity and transporting power are large. As before mentioned, the water supply is almost entirely derived from the rainfall and snow of the distant highlands; but a notable quantity of water is added by means of deep-seated springs, which, as previously pointed out, augment the body of water and the transporting power without contributing to the load.

And the supply of sediment, and especially of fine sand, is very great compared with the volume of water. "A cubic yard of running water in the Plateau County probably carries several times more sediment than the same quantity of water in the Atlantic rivers." This is because the soil and comminuted *débris* in these arid regions are not held together by vegetation, and the declivities of the valleys are great. The occasional showers in the Cañon district form floods, which rush with tremendous force down the steep lateral gorges, gathering up the loose *débris* until they form masses of liquid mud, and bowling along into the main stream huge stones of several tons weight. Then, again, the Mesozoic rocks are composed for the most part of clay and sand, and the cementing material is usually gypsum, which is, therefore, readily soluble, so that the supply of corroding material is unusually abundant.

When the waters of the river are low, the bared rock surfaces to the height of 50 to 60 feet above the ordinary summer level of the stream

* A Paper read before the Liverpool Geological Association, June 3rd, 1889.

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are seen to be highly polished and ground by the sandy waters, and worn into numerous pot holes.

"The great corrasive power of the Colorado is, therefore, due to the large quantity of sand which it carries and the high velocity given to its waters by the great declivity." It cannot be doubted that the gorge has been literally sawn out by the action of the stream which now occupies its depths, and in like manner the lateral gorges have been excavated by the streams which occupy or did formerly occupy their channels.

But it is pointed out that the corrading power of a river serves only to cut a narrow deep gorge equal in width to the width of the water surface. The process of widening this gorge is carried on by an entirely different agency, viz., that of *weathering*, which attacks the vertical cliff faces formed by the corrading process and slowly causes their recession, and which also carves out the detail. And, as there is every reason to believe that at the time when the great denudation took place the then surface of the country was sawn up by innumerable tributary streams into a vast plexus of cañons, the intervening blocks would afford an immense extent of surface for the attack of the weathering agencies. As Professor Powell in his preliminary report said of an adjoining district—"Every creek entering a river runs in a cañon, every brook tributary to a creek has cut a cañon; every rill born of a shower, and born again of a shower, and living only during these showers, has cut a narrow winding gorge through the solid rock, so that the whole of this region is traversed by a labyrinth of cañons."

II.—Why should the erosion of the Mesozoic strata have proceeded down to, but stopped at, the upper Carboniferous beds, so that the latter beds form the surface of the platform of the Grand Cañon district?

To understand the argument which furnishes the answer to this question, it is necessary to consider another principle of river action pointed out by Professor Powell, viz., the principle of "Base Levels of Erosion." When a river has cut down its bed nearly to sea level, so that the declivity is small, the velocity and the corrading power are also very small, and erosion is practically at an end. The velocity is only sufficient to enable the river to carry the detritus supplied to it from its basin. The river has found its base level, and all rivers tend towards such a condition of things if the area is stationary. A change in the elevation of a country, however, disturbs the equilibrium; depression converts the area into one of deposition, while, on the other hand, elevation gives new life to the corrading forces, and the river proceeds at once to deepen its channel. Continued and extensive elevation is, therefore, essential to the production of deep gorges. This element has not been wanting in the case of the district we are considering; for since the deposition of the lower Eocene beds (now forming the summit beds of the Terraces) there has been an elevation of from 11,000 to 18,000 feet, broken, however, as we shall presently see, by at least two prolonged intervals of rest.

When a river has reached its base level of erosion, however, and corrasion has ceased, all the operations of weathering will be in progress as actively as ever. This action will be exerted almost entirely on the faces of cliffs and slopes, where the disintegrated material does not remain to protect the underlying rocks. The higher the cliff the greater the amount of surface acted on, and, therefore, the greater the amount of material removed. And so, while the eroding action of the river is in suspense, all the cliff faces produced by the river and its network of tributary streams will furnish lines of attack for the weathering agents, and each will be receding as the material derived from it is conveyed to the river to be carried away. The river during the period of elevation blocked out the country in high relief, while during the stationary period, with the river at or near a base level, the masses of strata so cut up into sections will be slowly removed; and, given a sufficiently prolonged stationary period, the area will be reduced to a more or less uniform level, only slightly raised above the water surface. The contour at any intermediate epoch will, however, depend upon the details of the nature and arrangement of the beds, and the rate of denudation will depend also upon climatic conditions.

The elevation of the Grand Cañon district after the deposition of the lower Eocene beds found it covered by deposits from Permian to Eocene inclusive of at least 10,000 feet in thickness. Into this the Colorado and its tributaries rapidly sank their beds; and there are plenty of indications in neighbouring districts that the Eocene and Miocene periods were warm and humid, the present arid climate not having commenced, so that there would be a great network of tributary streams each forming its own cañon. The uplift, however, was such that by the time the river had sunk its bed to the summit of the Carboniferous strata it had reached a base level of erosion, and here the land stood so long that the weathering action on the innumerable vertical profiles exposed was enabled to remove almost all traces of the Mesozoic strata, except where in special cases they are protected by cappings of basalt.

The Carboniferous platform, therefore, marks a period of repose in the upheaval of the country, and affords a measurement of the amount of uplift. At the close of the local Eocene deposits the summit of the Carboniferous must have been at least 10,000 feet below the sea level, and that gives, therefore, the minimum amount of this first stage in the upheaval.

III.—We are now in a position to understand the fact of the outer and inner gorges. (*Fig.* 2.)

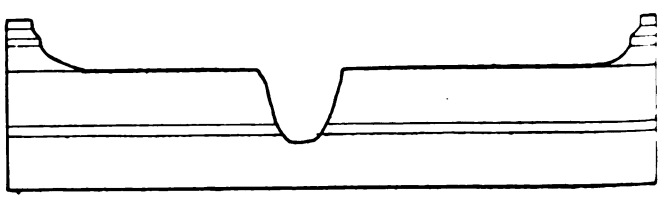

Fig. 2. Section of outer and inner gorges of Grand Cañon. Horizontal and vertical scales equal.

When the denudation had removed the Mesozoic strata and laid bare the Carboniferous platform, there occurred a second upheaval to the extent of 2,000 to 3,000 feet. This was probably towards the close of the Miocene epoch, when the climate was changing and becoming exceedingly dry; consequently most of the tributary streams disappeared, and only the Colorado itself and some of its larger tributaries remained to begin again the work of corrasion and to sink their beds. The gradual change of climate is shown by the fact that a number of lateral valleys were cut out to various depths in the great platform, but gradually were left unoccupied by permanent streams and ceased to deepen.

The process of upheaval, which was accompanied by volcanic outbreaks, was, however, again interrupted. "The uplifting action paused for a time. The volcanism ceased to be active. The river sought and found a new base level at the horizon of the great esplanade of the Grand Cañon. In its turn the process of corrasion rested." . . . . The newly-formed cliffs of the cañon were attacked by weathering agents and "receded from the river, gradually developing the broad avenue of the outer chasm. In the very few tributaries which survived the advent of the arid climate, the same process of sapping and recession of cliffs is discernible. When the cliffs of the outer chasms had receded from two to three miles away from the river another and more active period of upheaval set in. Again the country was hoisted, this time more than before. At once the corrasion of the river bed was renewed. The faults were increased. The volcanic fires were rekindled. Swiftly the inner gorge was scoured out, and the chasm assumed its present condition. At present the uplifting force is inactive, the volcanoes are extinct, the faults are not increasing, and the river has nearly, but not quite, reached another

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base level." During the first pause in the uplift, when the climate was moist and streams numerous, a vast amount of material was rapidly removed by the action of the weathering forces. But, in consequence of the great change in the nature of the climate and the almost total absence of permanent streams, during the second pause the only cliff faces exposed to the denuding forces were the faces of the cliffs forming the cañon of the main stream and its two or three remaining tributaries, and the result was merely to cause these lines of cliffs to recede farther and farther from the stream instead of to produce a similar effect on the faces of a vast number of blocks distributed over the whole district.

(To be continued.)

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between June 16th and July 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer ....Highest (July 1st)	30·48	Inches.
,, ,, ...Lowest (July 10th)	29·55	,,
,, ,, ...Mean	30·077	,,
,, ,, ... ,, for 22 years June	29·983	,,
,, ,, ... ,, ,, July	29·923	,,
Temperature..Highest (June 26th)	73·8	Deg. F.
,, ..Lowest (July 7th)	47·8	,,
,, ..Mean	60·3	,,
,, .. ,, for 22 years June	57·6	,,
,, .. ,, ,, July	60·8	,,
,, .. ,, of Evaporation	55·2	,,
,, .. ,, ,, for 22 years June	53·5	,,
,, .. ,, ,, ,, July	56·6	,,
(*b*) Rainfall.....Amount	0·779	Inches.
,, ,, ... ,, Mean for 22 years June	1·903	,,
,, ,, ... ,, ,, ,, July	3·044	,,
,, ...Number of Days on which Rain fell	7	
,, ...Greatest fall in 24 Hours (July 12th)	0·231	Inches.
Cloud .....Mean Amount (0 indicating clear sky, 10 overcast)	6·1	
,, ... ,, ,, for 22 years June	6·3	
,, ... ,, ,, ,, July	6·5	
(*c*) Wind .....Velocity, Greatest (July 7th)	33	Miles.
,, ... ,, Least (June 21st)	0	,,
,, ... ,, Mean Hourly	12·1	,,
,, ...Greatest Pressure on Square Foot (July 15, 10-20 a.m.)	19·7	Pounds.
,, ...Direction at time of Greatest Pressure	W	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
27	147	118	10	21	205	164	26	2

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

The weather from the 15th to the 21st of June was warm, bright, and fine, with an entire absence of rain. The weekly averages were:—Barometer 30·14 in.; mean temperature, corrected for daily range, 56·87°; humidity 70%; total sunshine 40·50 minutes; calm on four days, Easterly winds on three. From the 22nd to the close of the month no rain fell, the weather being calm, bright, and warm. On four days the mean temperature exceeded 60° F. The barometer averaged 30·132 in.; temperature 59·75°; humidity 66%; total sunshine 49 hours 30 minutes.

The bright, hot weather of June enabled farmers to secure the good hay crops in excellent condition, and also rapidly advanced the maturing of corn and root crops. The mean barometric pressure, 30·061 in., is somewhat above the average; small range, and few oscillations. The mean temperature, 57·57°, was 5·2° higher than in 1888 and more equable, and about 2° above the average. The temperature of the soil at one and two feet deep, and of water at one foot deep, was about 5° above the corresponding month last year. Rain fell on only four days; total 0·574 in., fully 2 in. below the average, and the least recorded in any month for 20 years. Bright sunshine recorded on 28 days to the extent of 34% of the time the sun was above horizon.

The warm, bright weather continued until the 6th July, making an absolute drought of 21 days. On the 6th the barometer dropped 0·35 in., and indications of a change became manifest. The mean pressure for the first week was 30·198 in., and range 0·73 in.; temperature variable, mean 58·58; humidity 67%; rainfall 0·047 in.; sunshine 44 hours 5 minutes; wind Easterly. During the second week the weather was unsettled, with passing showers. Barometer irregular and low, with a mean of 29·851 in., and range 0·39 in.; temperature variable, mean 57·74°; humidity 71%; total rainfall 1·642 in. (1 in. falling on the 12th); sunshine 33 hours 10 minutes; gentle Easterly and Westerly breezes.

The following table of accumulated factors of vegetable growth from January 1st to the 14th July shows the current season has been more favourable to agriculture than either of the two preceding :—

Accumulations of	1887.	1888.	1889.
Growing temperature	2051·4°	1905·4°	2183·0°
Rainfall	11·61 in.	14·249 in.	15·953 in.
Bright sunshine	719 hrs. 13 m.	482 hrs. 36 m.	542 hrs. 48 m.

W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, July 18, 1889.

Sheffield.

METEOROLOGICAL SUMMARY.

June, 1889.	TEMPERATURE. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	* Means for June. Daily Max.	Daily Min.	RAINFALL. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for June* Ins.
Sheffield ...	78°	2nd	46°	11th	59°	—	—	0·24	2	0·17	9th	—
Spurn Head.	72°	3rd	48°	1st	57°	—	—	0·17	4	0·12	2nd	—
York	80°	27th	46°	11th	61°	66°	48°	0·36	3	0·25	8th	2·45
Barrow	72°	20th	42°	11th	59°	—	—	1·29	7	0·45	9th	—
Liverpool ...	74°	2nd	46°	1st	59°	64°	51°	0·85	6	0·50	2nd	1·96
Holyhead ...	71°	21st	48°	5th	57°	62°	52°	0·76	8	0·31	2nd	2·10
Oxford	79°	27th	48°	19th	60°	67°	49°	1·85	8	1·06	7th	2·28
London	80°	27th	47°	1st	63°	69°	51°	2·18	7	0·84	9th	2·12

* The means of Temperature and Rainfall for June are for 15 years.

June 16 to July 15, 1889.

PRESSURE.

On the 16th of June pressure was high, ranging from 30·0 in. to 30·1 in., and it increased to 30·2 in. on the 17th, and was the same on the 18th and 19th, but giving way slightly on the latter date. From the 20th to the end of June it varied but little, keeping slightly above 30·0 in. in all places, and had very little range. On July 1st it had risen to 30·4 in., and remained the same on the 2nd, but fell to 30·3 in. on the 3rd, and to 30·1 in. on the 4th, but recovered slowly again on the 5th. It declined a little on the 6th, and on the 7th there was a decided fall, pressure ranging from 29·6 in. in the E. to 29·8 in. in the W., and it changed very little on the 8th and 9th. On the 10th pressure was lowest in the S.W., where it had fallen to 29·6 in., and was up to 29·8 in. in the N.E. On the 11th the barometer was rising generally, but was below 30·0 in. It continued to rise on the 12th, and reached 30·0 in., remaining at this height on the 13th, but fell to 29·8 in. on the 14th,

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and to 29·7 in. in the N. on the 15th, and 29·9 in. in the S. The barometer for nearly the whole of the month has been remarkably high and steady, and has been very even all over the kingdom.

The Weather.

From June 16th to the 22nd fair dry weather was experienced in nearly all parts of the kingdom. There was a very slight thunderstorm at Oxford on the 22nd, and 0·10 in. of rain fell at Barrow on the same day, but there was no rain during the week at any of the other places in the above summary. The sky on the whole was clear and temperature moderately high. During the following week (June 23rd to 29th) the weather remained dry and fine, and temperature was high, exceeding 80° at London, Loughborough, York, and other places. The only rain was 0·02 in. at London on the 24th. From June 30th to July 6th the weather continued fair and the rainfall was very slight and local, but towards the close of the week temperature was giving way, and there was an increase of cloud and fog. There were some light showers at Barrow, Liverpool, and Holyhead on the 6th, but no rain at any of the other places in the table above. During the week ending July 13th the weather underwent a decided change for the worse, and there was considerable falls of rain in many places, and thunderstorms were experienced in various localities. During a thunderstorm at Cambridge on the night of the 12th as much as 2·2 in. of rain fell. Temperature gave way decidedly, and the air was cold at times. Rain fell on six days at London, five at Liverpool, Holyhead, and Oxford, four at Sheffield and Spurn, three at York, and two at Barrow.

The weather during the month of June and the early part of July was unusually dry, and at some places no rain fell for an entire month. At Sheffield there was no rain from June 9th to July 9th. At Spurn and York the dry period continued from June 9th to July 7th. At Barrow there was only 0·20 in. of rain between June 9th and July 6th, and only 0·10 in. of rain at Liverpool in the same period. At Holyhead, except for a slight shower on the 29th, when 0·01 in. of rain fell, there was no rain from June 14th to July 6th; and at London there was only 0·02 in. of rain from June 15th to July 8th, while at Oxford there was no rain from June 15th until July 9th.

Sun Spots, June 16 to July 15.

On the 17th June there was a large spot above the equator and very near to the eastern limb, with a prolongation about the centre towards the east, and surrounded by a well-defined regular ovate penumbra, and followed by bright faculæ, in which were some smaller spots. This was the largest spot that had appeared on the sun for many months, and during its visibility it underwent considerable change. On the 18th the large spot had become crescent shaped, with its concavity to the east and its northern cusp jagged, the smaller spots still following. On the 21st the spot was rounder with the periphery irregular, and the penumbra was also jagged on the east and north. There was a small spot above the larger one and three others following. On the 24th the following spots had become smaller and were nearer to the large one, which remained as big as at first but much changed in shape, having an indent or concavity on its northern side, and the penumbra had become irregular in outline. On the 25th the spot was divided into two portions, the small part north and the larger part south, both enclosed in the same penumbra, and the following spots had disappeared. On the 26th it was still divided into two and much elongated, the penumbra having a decided indent about its centre. On the 27th the two spots were still visible near the western limb, but were much foreshortened, and on the 28th had disappeared, though the faculæ were visible on the western limb. No other spots appeared till the 12th of July, when there was a small round spot about 30° from the eastern limb, and no further observations could be made till the 16th of July.

E. Howarth, F.R.A.S.

Museum and Observatory, Sheffield, July 20, 1889.

List of the Plants of the Isle of Man.—Part III.

By the Rev. Samuel Gasking, B.A., F.G.S.,

Corresponding Member of the Isle of Man Natural History and Antiquarian Society, Member of Council of Liverpool Naturalists' Field Club, &c.

Inula dysenterica—Flea-bane.
Bellis perennis—Daisy.
Chrysanthemum segetum—Corn marygold.
Do. leucanthemum—Great white ox-eye.
Matricaria parthenium—Common feverfew.
Do. inodorum—Scentless mayweed.
Variety 2.—*Maritimum.*
Anthemis cotula—Stinking chamomile.
Achillea ptarmica—Sneeze-wort.
Do. millefolium—Yarrow.

Order 47.—*Campanulaceæ.*

Campanula rotundifolia—Round-leaved harebell.
Campanula hederacea—Ivy-leaved do.
Jasione montana—Annual sheep's-bit.

Order 48.—*Ericaceæ.*

Erica tetralix—Cross-leaved heath.
Calluna vulgaris—Ling.
Vaccinium myrtillus—Bilberry.
Do. vitis-idæa—Cow-berry.

Order 49.—*Aquifoliaceæ.*

Ilex aquifolium—Holly.

Order 50.—*Oleaceæ.*

Ligustrum vulgare—Privet.
Fraxinus excelsior—Ash.

Order 52.—*Gentianaceæ.*

Gentiana campestris—Field gentian.
Erythræa centaurium—Common centaury.
Do. pulchella—Dwarf do.
Do. littoralis—Tufted do.
Do. latifolia—Broad-leaved do.
Menyanthes trifoliata—Buckbean.

Order 53.—*Polemoniaceæ.*

Polemonium cæruleum—Jacob's ladder.

Order 54.—*Convolvulaceæ.*

Convolvulus arvensis—Small bindweed.
Do. sepium—Great do.
Di. soldanella—Seaside do.

Order 56.—*Solanaceæ.*

Hyoscyamus niger—Henbane.
Solanum nigrum—Common nightshade.
Do. dulcamara—Bitter-sweet.

Order 56.—*Scrophulariaceæ.*

Verbascum thapsus—Great mullein.
Veronica scutellifolia—Thyme-leaved speedwell.
Do. scutellata—Marsh speedwell.
Do. anagallis—Water do.
Do. beccabunga—Brooklime.
Do. officinalis—Common speedwell.
Do. chamædrys—Germander do.
Do. arvensis—Wall do.
Do. Buxbaumii—Buxbaum's do.
Bartsia odontites—Red bartsia.
Euphrasia officinalis—Eyebright.
Rhinanthus crista-galli—Yellow-rattle.
Melampyrum pratense—Yellow cow-wheat.
Pedicularis palustris—Marsh louse-wort.
Do. sylvatica—Field do.
Scrophularia nodosa—Knotted fig-wort.
Digitalis purpurea—Foxglove.
Antirrhinum majus—Great snapdragon.
Linaria cymbalaria—Ivy-leaved toad flax.
Do. vulgaris—Yellow do.

Order 57.—*Orobanchaceæ.*

Orobanche rapum—Great broom-rape.
Lathræa squamaria—Great tooth-wort.

Order 59.—*Labiatæ.*

Lycopus Europæus—Gipsy-wort.
Mentha piperata—Peppermint.
Do. aquatica—Watermint.
C. hirsuta.
Do. pulegium—Pennyroyal.
Thymus serpyllum—Wild thyme.
Calamintha nepeta—Lesser calamint.
Teucrium scorodonia—Wood germander.
Ajuga reptans—Common bugle.
Lamium album—White dead-nettle.
Do. maculatum—Spotted do.
Do. amplexicaule—Henbit do.
Variety 2.—*Intermedium.*
Do. purpureum—Red dead-nettle.
Galeopsis ochroleuca—Downy hemp-nettle.
Do. tetrahit—Common do.
Do. versicolor—Large-flowered do.
Stachys palustris—Marsh wood-wort.
Variety 2.—*Ambigua.*
Do. sylvatica—Hedge wound-wort.
Do. arvensis—Corn do.
Nepeta glechoma—Ground ivy.
Prunella vulgaris—Self-heal.
Scutellaria minor—Lesser skull-cap.

Order 60.—*Boraginaceæ.*

Myosotis palustris—Water scorpion grass, or forget-me-not.
Do. repens—Creeping water scorpion grass.
Do. cæspitosa—Tufted do.
Do. arvensis—Field do.
Do. collina—Early field do.
Do. versicolor—Yellow and blue do.
Symphytum officinale—Comfrey.
Borago officinalis—Borage.
Echium vulgare—Common viper's bugloss.

Order 61.—*Lentibulariaceæ.*

Pinguicula vulgaris—Common butter-wort.
Do. lusitanica—Pale do.

Order 62.—*Primulaceæ.*

Primula vulgaris—Common primrose.
Do. veris—Cowslip.
Do. farinosa—Bird's-eye primrose.
Lysimachia nemorum—Wood loose-strife.
Anagallis arvensis—Scarlet pimpernel.
Do. tenella—Box do.
Centunculus minimus—Small chaffweed.
Samolus valerandi—Brookweed.
Glaux maritima—Sea milk-wort.

Order 63.—*Plumbaginaceæ.*

Armeria maritima—Sea pink.
Statice limonium—Common sea lavender.

Order 64.—*Plantaginaceæ.*

Plantago major—Greater plantain.
Do. lanceolata—Ribwort do.
Do. maritima—Seaside do.
Do. coronopus—Buck's-horn do.
Littorella lacustris—Plantain shoreweed.

Order 66.—*Chenopodiaceæ.*

Chenopodium album—White goose-foot.
Atriplex Babingtonii—Spreading-fruited orache.
Do. patula—Common orache.
A. angustifolia.
Do. littoralis—Grass-leaved orache.
Beta maritima—Beet.
Salsola kali—Prickly salt-wort.
Suæda maritima—Annual sea-blite.
Salicornia herbacea—Jointed glass-wort.

Order 67.—*Polygonaceæ.*

Polygonum bistorta—Common bistort.
Do. lapathifolium—Pale-flowered persicaria.
Do. persicaria—Spotted do.
Do. aviculare—Common knot-grass.
Do. Raii—Ray's do.
Do. convolvulus—Climbing bistort.
Rumex maritimus—Golden dock.
Do. crispus—Curled dock.
Do. nemorosus—Wood do.
A. viridis.
Do. acetosa—Common sorrel.
Do. acetosella—Sheep's do.

Order 72.—*Empetraceæ.*

Empetrum nigrum.—Black crowberry.

Order 73.—*Euphorbiaceæ.*

Euphorbia helioscopia—Sun spurge.
Do. Portlandica—Portland do.
Do. exigua—Dwarf do.
Do. Peplus—Petty do.

Order 74.—*Urticaceæ.*

Urtica urens—Small nettle.
Do. dioica—Great do.
Parietaria officinalis—Wall pellitory.
Humulus lupulus—Hop.

Order 75.—*Ulmaceæ.*

Ulmus campestris—Common elm.

Order 76.—*Cupuliferæ.*

Quercus robur—British oak.
Fagus sylvatica—Beech.
Carpinus betulus—Hornbeam.
Corylus avellana—Hazel.

Order 77.—*Betulaceæ.*

Alnus glutinosa—Alder.
Betula alba—Birch.

Order 78.—*Salicaceæ.*

Populus alba—Great white poplar.
Do. tremula—Aspen.
Salix pentandra—Bay-leaved willow.
Do. fragilis—Crack do.
Do. caprea—Goat do.
Do. aurita—Round-eared sallow.

Order 79.—*Myricaceæ.*

Myrica gale—Bog myrtle.

(to be continued).

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Societies and their Summer Work.

PHOTOGRAPHY now numbers among its votaries many students of science, and the number of societies established all over the country for the benefit of amateur and professional photographers is yearly increasing. The Manchester Amateur Photographic Society continues to meet regularly both for evening meetings and outdoor rambles. At recent meetings of this society some very interesting examples of "pin-hole" photography were exhibited by Mr. W. T. Farrow, and a stereoscopic slide made by the "Kodak," by Mr. H. Smith. Mr. Chadwick showed a set of six negatives to illustrate various methods of development. Summer rambles have been held at Lymm, Kirkstall, Whalley Abbey, Chester, Trentham, and the August Bank Holiday excursion is fixed for "the Dukeries."

The Lancashire and Cheshire Antiquarian Society recently spent a profitable week in the Isle of Man, under the leadership of Professor Boyd Dawkins. The Manchester Microscopical Society held a successful field meeting at Southport and Birkdale (notwith standing unfavourable weather), and the Scientific Students (of the same city) journeyed to Chester, where an afternoon was spent in surveying the museum and antiquities of the old city, and in noting the trees and flowers along the banks of the Dee. The summer programme of this association includes excursions to the Kettleshulme Valley, Dove Holes and Buxton, Delamere, Rivington, Woodley, Kersal, and Dunham Park.

The Leeds Naturalists' Club and Scientific Asssociation lately visited the district between Pateley Bridge and B imham Rocks, under the guidance of Mr. Wm. Storey, whose accurate local information in the departments of geology, botany, pond life, entomology, and ornithology was of great assistance. A marine dredging expedition was arranged for July 20, to start from Scarborough and terminate at Filey, Major Woodall having kindly placed a steam launch at the disposal of the society. A party of students from the Technical College at Huddersfield made an investigation of the Craven "faults," with Mr. E. Brooke as leader, visiting Gordall Scar, Malham Cove. The Leeds Co-operative Society Naturalists' Club have held frequent excursions and country meetings, one of the most recent visits being to the neighbourhood of Cookridge, where the beauties of Hawksworth Wood and Kirkstall Abbey were examined with much interest and pleasure. The report of the third annual meeting of the Yorkshire College Textile Society stated that the work of the season had been satisfactory, and that the lectures and papers given during the last two seasons would shortly be published, illustrated in an efficient manner. A presentation was made by a number of the students to Professor Beaumont on his recent retirement, owing to his ill health.

Societies.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The fifty-ninth meeting of this association will be held this year at Newcastle-on-Tyne, commencing on Wednesday, 11th September. Prof. W. H. Flower, C.B., LL.D., F.R.S., &c., is the president-elect; Prof. A. W. Williamson, F.R.S., the general treasurer; Captain Sir Douglas Galton, K.C.B., and Mr. A. G. Vernon Harcourt, F.R.S., the general secretaries; whilst Professors P. P. Bedson, D.Sc., and J. H. Merivale, B.A., will act as local secretaries; and Mr. Thomas Hodgkin, B.A., as local treasurer. The general committee will meet on the 11th September for the election of sectional officers and the despatch of other ordinary business, including the report of the council for the past year. This committee will meet again, on 16th September, to appoint the officers for 1890 and decide upon the place of meeting in 1891. The concluding meeting will be held on the 18th September to receive the report of the committee of recommendations. The president will deliver the annual address on the 11th, and the different sections will meet on the 12th, and continue to sit daily until the 18th. The reception room will be opened at the University of Durham College of Medicine on Monday, September 9th, for the issue of tickets to members, associates, and ladies, and for supplying lists and prices of lodgings and other information to strangers on their arrival. Since the last visit of the association in 1863 several public edifices have been erected, which will enable the committee to provide convenient rooms, at no great distance apart, for the use of the sectional and other meetings. A special committee has been busily engaged in organizing excursions to various places of interest, and offers of hospitality have been received from the Duke of Northumberland, the Earl of Carlisle, Sir George Trevelyan, the University of Durham, and the Corporation of Berwick-on-Tweed. The border country comprises a great number of points of interest in British, Roman, and Mediæval Archæology, and also Geology. Both the previous meetings of the association at Newcastle were most successful, and the facilities for holding a large meeting are now much greater than formerly. There will be the usual discourses and evening *soirées* during the meeting.

SOCIETY OF CHEMICAL INDUSTRY.—This large and important society held its annual meeting this year in London, and commenced its proceedings with a meeting in the Royal Institution, under the presidency of Mr. Ludwig Mond, F.I.C., F.C.S., &c. The report of the council, read by the secretary, Mr. C. G. Cresswell, stated that the membership of the society had increased from 2395, as reported last year, to 2445, or a net increase of 50. During the year 223 members had been elected, and 173 had been removed by death, resignation, and other causes. During the year 55 papers and 5 communications had appeared in the journal, which was increasing in importance as a work of reference, and the Publication Committee is using every effort to add to its value. Within the last few weeks Mr. Watson Smith had arranged to give up his lectureship at the Victoria University and take up his abode in London, and make the editing of the journal his main occupation; and the council hoped that in securing for the future his services, which had been so valuable in the past, it was promoting the best interests of the society, in whose continued prosperity the journal is so important a factor. The treasurer, Mr. Rider Cook, reported that in the receipts of June last there was the sum of £3688 15s. 9d. invested, and £1214 4s. 5d. in the bank, as against £2,088 11s. 9d. invested, and £1761 12s. 9d. in the bank a year ago. The report having been adopted and the treasurer's statements passed by the meeting, a ballot was taken for members of the council for the ensuing year, resulting in the election of the following:—president, Sir Lowthian Bell, Bart., F.R.S.; vice-president, R. Forbes Carpenter, Manchester; Professor F. Clowes, Nottingham; Sir J. Neilson Cuthbertson, Glasgow; Professor James Dewar, Cambridge; James Duncan, London; Dr. John Evans, Watford; S. H. Johnson, London; Ludwig Mond, Northwich, Cheshire; Dr. Hugo Miller, London; Dr. W. H. Perkins, London; Dr. Edward Schunk, Manchester; and Professor Tilden, Birmingham; other members of council, L. Archbutt, Derby; S. B. Boulton, London; John Brock, Widnes; John Calderwood, London; A. M. Chance, Birmingham; A. E. Fletcher, London; B. E. R. Newlands, London; John Pattinson, Newcastle-on-Tyne; John Spiller, London; E. C. C. Stanford, Glasgow; J. C. Stevenson, M.P., South Shields; A. Norman Tate, Liverpool; treasurer, E. Rider Cook, London; foreign secretary, Dr. Ferdinand Hurter, Widnes. In the afternoon about 230 members visited Messrs. Doulton & Co.'s potteries, where they were entertained to luncheon, and after luncheon Sir Henry Doulton, in reply to a hearty vote of thanks proposed to him in graceful terms by the president, spoke of the desirability of connection between art and industry, and also stated that the art work there produced was really to a great extent the product of native and even Lambeth talent, the best of which had been cultivated in the Lambeth School of Art, which the

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firm commenced and had much pleasure in supporting. Several of the members also visited the Archbishop's Palace at Lambeth. In the evening the President and Mrs. Mond held a reception in the Grosvenor Gallery, New Bond Street, which was very largely attended by the members of the society and other scientific bodies. On the Thursday, a special steamer conveyed about 250 members first to the works of the Mantré Saccharine Company at Hammersmith, where, under the guidance of Messrs. E. G. Francis, managing director, Bechler, manager, Dr. Bernard, chemist, and Mr. C. C. Hutchison, they were afforded an opportunity of viewing several processes there carried on, and also partook of a *recherchè* luncheon considerately provided by the company. Afterwards they re-embarked and proceeded by the river to Kew, where a large number assembled at the Economic Museum No. 1, and, in the absence of the director, were, under the guidance of the assistant director, Mr. J. R. Jackson, and Mr. G. Nicholson, taken over the several museums, the palm house, the collection of economic plants, and Miss North's splendid collection of beautiful drawings of plant life, and the Arboretum. From Kew the party proceeded to the Star and Garter Hotel, at Richmond Hill, where they were met by many other members, and over 200 sat down to the annual dinner. After dinner many toasts were given and replied to, the general tone of the speeches being the necessity for close union of practical and applied science; the proceedings of the evening closed by a hearty vote of thanks to the hon. secretary of the London section, Mr. Thomas Tyrer, for so admirably planning and carrying out the arrangements of the meeting, who in his reply expressed his thanks for the valuable aid given to him by his assistant, Mr. R. Pierce, and the general secretary, Mr. C. G. Cresswell. On the following day, Friday, several places of interest to the members of the society were visited, which were mentioned in the programme of the meeting, given in our last issue. Altogether the meeting was a great success.

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Victoria Institute.—At the annual meeting of this society, held on 1st July, Sir George Stokes, Pres. R.S., in the chair, a valuable paper by Prof. A. H. Sayce, LL.D., of Oxford University, was read on the subject of cuneiform inscriptions. The author gave an historical description of what has become known as to the conquests of Amemnophis III., the palace and its archives, which have only lately been discovered, and which the professor went last winter to investigate on the spot before writing the address for the Victoria Institute. Of the tablets and inscriptions he said:—"From them we learn that in the fifteenth century before our era, a century before the Exodus, active literary intercourse was going on throughout the civilised world of Western Asia, between Babylon and Egypt and the smaller states of Palestine, of Syria, of Mesopotamia, and even of Eastern Kappadocia. And this intercourse was carried on by means of the Babylonian language, and the complicated Babylonian script. This implies that, all over the civilised East, there were libraries and schools where the Babylonian language and literature were taught and learned. Babylonian, in fact, was as much the language of diplomacy and cultivated society as French has been in modern times, with the difference that, whereas it does not take long to learn to read French, the cuneiform syllabary required years of hard labour and attention before it could be acquired. We can now understand the meaning of the name of the Canaanitish city which stood near Hebron, and which seems to have been one of the most important of the towns of Southern Palestine. Kirjath-Sepher, or 'Book-town,' must have been the seat of a famous library, consisting mainly, if not altogether, as the Tel el-Amarna tablets inform us, of clay tablets inscribed with cuneiform characters. As the city also bore the name of Debir, or 'Sanctuary,' we may conclude that the tablets were stored in its chief temple, like the libraries of Assyria and Babylonia. It may be that they are still lying under the soil, awaiting the day when the spade of the excavator shall restore them to the light. The literary influence of Babylonia in the age before the Israelitish conquest of Palestine explains the occurrence of the names of Babylonian deities among the inhabitants of the West." Referring to those who have formed opinions as to the non-historical character of the Pentateuch, Professor Sayce said:—"The Tel el-Amarna tablets have overthrown the primary foundation on which much of this criticism has been built."

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Edinburgh Architectural Association.—The annual excursion of this association took place to Peebles and the vicinity. Arriving in Peebles about twelve o'clock, the party drove to Neidpath Castle, where Mr. David Macgibbon explained that it had originally been one of the keeps of the 14th century, and had been the residence of the Hays, of Yester. It was an example of the ⊐ plan of the second period, built with very heavy walls, in some cases more than ten feet thick. The party also visited Drochil Castle, Lyne Church, and Roman Camp, Barns Tower, and Peebles churches. Drochil Castle, Mr. Macgibbon explained, had been built by the Earl of Morton shortly before his execution in 1551; it was intended for a palace rather than a castle. The churches were examined under the conductorship of Mr. Hippolyte J. Blanc. He noted Lyne Church as one of a like kind to pre-Reformation churches found in various parts of Scotland. It was a structure of about the end of the 15th century, and was singularly devoid of architectural detail or ornamentation.

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Marine Biological Association.—The annual general meeting was held in the rooms of the Royal Society, on 26th June. In the absence of Professor Huxley, the chair was taken by Sir. E. Bowman. The report of the Council showed that a most satisfactory amount of work has been done at Plymouth. Studies on various matters connected with the fishing industry are being carried on. Several naturalists have utilized the laboratory for carrying on independent biological researches. The director reports that the aquarium is in good order, and a substantial increase has been made in the library.

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International Zoological Congress at Paris.—The following are subjects proposed for discussion at the International Zoological Congress, to be held in Paris (August 5-10):—Adoption of rules on the nomenclature of organisms, and of an international scientific language; determination of regions the fauna of which calls for investigation; methods of investigation and procedure in preparation and preservation of animals; the use of embryology in classification; relations between living and fossil fauna. The secretary's address is 32, Rue de Luxembourg.

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Botanical Congress at Paris.—The *Société Botanique de France* has now completed the arrangements for their International Congress, to be held from 20th to 25th August. The following programme has been issued:—*Tuesday, 20th August:* Opening meeting at l'Hôtel de la Société d'Horticulture, Rue de Grenelle 84. In the evening a reception of foreign members will be held. *Wednesday, 21st:* Morning session—Discussion on the utility of establishing between the different botanical societies and the different botanical museums a general agreement for the execution of maps showing the distribution of species and genera of plants on the globe. *Thursday, 22nd:* Excursions to the environs of Paris. *Friday, 23rd:* Morning session—Discussion on the characters furnished by vegetable physiology as an aid to classification. In the afternoon visits will be paid to the collections in the Museum of Natural History and other scientific institutions. *Saturday, 24th,* will be devoted to miscellaneous communications and visits to the Exhibition. *Sunday, 25th:* Banquet to foreign botanists. In the following week various botanical excursions will be held, of which the programme will be definitely arranged at the Congress.

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LIVERPOOL NATURALISTS' FIELD CLUB.—On Saturday, June 22nd, the fourth field meeting of the present session was held at Hawarden. The party, about 150 in number, the largest muster of recent years, proceeded in two sections, about 30 going by train to Broughton Hall and walking on to Hawarden; the remainder driving in waggonettes through Eastham and Ledsham to Queensferry. The drive occupied about two and a half hours each way, which left only a short time for a visit to the park, &c., and very little botanical work was done. The order prize, for *Geraniaceæ* and *Gramineæ*, was awarded to Mr. R. D. Brown, with 22 specimens; the prize for the largest collection of plants in flower or fruit to Miss Gibson for 73 species; bouquet prize, Miss Agnes Hunter. The botanical enigma was solved by Mrs. Edwin Davies, Mrs. Wood, Mrs. Waugh, Mrs. Bodell, Mrs. Martin, Miss M. E. Clementson, Miss F. M. Clementson, Miss H. T. Hunter, Miss E. M. Wood, Miss Joule, Miss Bingham, Miss M. Turmeau, Miss E. Turmeau, Miss E. Jee, Miss Moss, Miss Pickering, Mr. D. Price, Mr. R. H. Day, Mr. J. Mackerell, and Mr. R. D. Brown, the plant being *galium aparine*, or goose-grass cleavers.—— The following field meeting was held on Saturday, July 6th, the locality visited being Barton and Haskayne, on the Cheshire Lines Railway. The district explored lies between Barton and Formby, and is flat and uninteresting to the ordinary visitor. This may account for the smallness of the attendance, 36 members only putting in an appearance. These, however, had an afternoon of thorough enjoyment, the weather being all that could be desired, and the opportunity for botanical work such as is rarely afforded. Almost all the party were enthusiastic workers in the field and their efforts were awarded beyond expectation. Some very interesting plants were found, including *utricularia vulgaris*, bladderwort; *Trifolium filiforme*, least yellow trefoil; *Ranunculus lingua*, greater spear-wort; *Myriophyllum verticillatum*, whorled water milfoil; *Hottonia palustris*, water violet; and *Pedicularis palustris*, upright red-rattle. The following prizes were awarded:—The orders of the day, *Rubiaceæ*, *Polygonaceæ*, and *Typhaceæ* to Mrs. Wood, with 15 species; and for the best flat bouquet to Miss M. E. Clementson. The botanical enigma, *Alisma ranunculoides*, was found and solved by Mrs. Edwin Davies, Mrs. Wood, the Misses M. E. Clementson, E. M. Wood, F. M. Clementson, A. Pickering; Messrs. D. Price, F. Birks, E. Davies, R. D. Brown, P. Macdonald, and J. Mackarell. A few of the members returned via Formby, but the majority walked back to Barton Station, the railway company kindly stopping a train about 7-35, Liverpool being reached at 8-20. Tea was provided by the club caterer, Mr. W. J. Holmes, at Formby. Besides the long excursions there have been some enjoyable evening field meetings, which in point of interest and attendance of members have been very successful. These were to Hightown and Formby on June 13th; Halewood and Hunt's Cross, June 27th; Wallasey Sandhills, July 11th. On each of these occasions good botanical work was done, and many interesting plants were found.

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THE WARWICKSHIRE NATURALISTS' AND ARCHÆOLOGISTS FIELD CLUB held their first summer meeting on May 23rd, 1889, at Towcester, in Northamptonshire. The geologists walked along the railway cutting between Towcester and Olney to examine the sections showing Upper Lias resting on Northampton sand (Inferior Oolite) and also the Great Oolite and overlying Boulder Clay. At Roade a large quarry of Great Oolite was visited abounding in fossils, and further on another one, where numerous corals have been found well exposed in this section. Driving on to Northampton a fine section of Upper Lias was seen in a large brick pit, which has yielded many interesting fossils to the researches of Mr. Beeby Thompson and other local geologists. Mr. Thompson met the party at Roade and explained the various sections on the way. At one spot the overlying drift, resting on Great Oolite, consisted mainly of sand with some masses of ironstone and occasional flints, proving, with the exception of the latter, that the main part had been derived from the Inferior Oolite of the district. The junction of the Upper Lias with the Northampton sand was seen in several sections visited, these showing perfect conformity, which does not accord with an opinion held, it appears, by some geologists, but with which Mr. Thompson does not agree, that in the district round Northampton there is a want of conformity between the two formations. The archæologists visited the churches at Towcester, Easton, Neston, Stoke, Ashton, Roade, and St. Sepulchre's and St. Peter's, at Northampton. The former is a fine example of the transition period, with a circular portion resembling the famous Temple Church; the latter is a splendid specimen of late Norman, and especially interesting to all geologists because it contains a monument to William Smith, the father of English geologists. The meeting was very well attended, and the members dined together at the Peacock hotel, the chair being taken by their president, the Rev. P. B. Brodie, M.A., F.G.S.

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SOCIETY OF PUBLIC ANALYSTS.—This society commenced its annual country meeting in Liverpool on the 19th July. Soon after the arrival of the members a visit was paid, at the invitation of Dr. Campbell Brown, to the laboratories of University College. In the evening the members and their friends dined together at the Grand Hotel, Mr. Alfred Allen (of Sheffield and London) presiding. Among those present were Dr. Voelcker, Messrs. Otto Hehner, Bernard Dyer, and H. Faber (London); W. Thomson (Manchester); G. Embrey (Gloucester); Dr. Campbell Brown, Messrs. A. Norman Tate, G. Watson Gray, S. Lee, O. W. Jeffs (Liverpool), besides several ladies. After dinner some time was spent in discussing matters pertaining to the professional work of public analysts and chemists. On the following day the members visited the Albert Dock Warehouses and other parts of the Mersey Dock Estate, and noted the different exports and imports, methods of storage, &c. They afterwards proceeded to Llandudno.

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ROYAL GEOGRAPHICAL SOCIETY.—A large number of ladies and gentlemen, members of the Royal Geographical Society and their friends, assembled in the lecture theatre of the University of London, Burlington Gardens, to hear Dr. Fridtjof Nansen read his paper on his journey across Greenland. The chair was taken by the president of the Society, Sir M. E. Grant-Duff. Dr. Nansen, on entering the room, received a hearty applause of welcome, and after having been introduced to the meeting by the president proceeded to read his paper. In his introductory remarks, Dr. Nansen travelled over well-known ground in referring to the former attempts to penetrate into Greenland. His forefathers, the Vikings, who first discovered the country, maintained, he said, that although the coast was icebound and the country along the shore a mass of glaciers, the interior was a fertile country, with green fields. It was in 1882 that he first conceived the idea of the expedition and it soon became evident to him that the ski (the Norwegian snow shoes) were the very things for crossing Greenland. The next thing of importance to settle was what place to start from, and he finally decided to begin his journey from the east coast. When first he spoke of his idea to cross Greenland people said he was either mad or tired of life. He persevered, however, and last year, with the assistance of Dr. Gamel, of Copenhagen, he was enabled to set out on his expedition, accompanied by three Norwegians and two Lapps. In September they had reached a height of 9,000 feet above the level of the sea. They were then on an extensive ice-plateau, which resembled a frozen sea, and for more than two weeks they travelled over this desolate and intensely cold region—so severe, indeed, that in the nights the thermometer fell below the scale, and sometimes reached 45 degress and 50 degrees below the freezing point. For one month they had no water, but were obliged to melt ice and snow. On the 19th a favourable wind sprang up. On the 24th they at last reached the zone of bare land on the west

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coast, and on the 26th day they arrived at Ameralik, and had thus performed the difficult task of travelling right across Greenland's icefields. The expedition arrived too late at Godthaab to catch the last homeward bound ship of the season, and had, therefore, to remain there till April this year. During the winter they had the best opportunity of studying life among the Eskimoes. The scientific results of the expedition have not yet been fully worked out. The observations made refer to questions of a geographical, geological, and meteorological nature. The expedition has, Dr. Nansen believes, proved that the whole of the interior of Greenland is covered by an immense shield-shaped cap of ice and snow, which in some places must have a thickness of at least 5,000 or 6,000 feet. Another point of interest was the very low temperature found in the interior, which does not seem to agree with the received meteorological laws. Dr. Nansen believed that in its formation Greenland was very much like Scotland and Norway, the latter of which has gone through a similar glacial period to that through which Greenland is now passing. He thought that the best way of solving the problems of the Great Ice Age was to examine the places where similar conditions are now found, and no better place could be found than Greenland, the coldest place on earth. His expedition was the first to cross it, but he hoped it would not be the last. Dr. Nansen was warmly cheered as he sat down after reading his interesting paper. In the discussion which followed, Sir L. McClintock wished to express his great admiration of the feat which Dr. Nansen had performed. It was only due to his ability and energy that this remarkable journey across Greenland had been carried to a successful issue, and that the scientific world now, for the first time, became acquainted with the interior of that country. After some remarks from Dr. Rae, Sir Allen Young, and Sir E. Ommanney, the President tendered the thanks of the Royal Geographical Society to Dr. Nansen, and said that he had put on record a most remarkable achievement, boldly planned, resolutely undertaken, and admirably carried out. To have taken, at the age of 27, a foremost place among Northern travellers was almost sufficient for fame. All who knew their distinguished guest believed that his energy would not be calmed, but rather stimulated by what he had done.

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MANCHESTER GEOGRAPHICAL SOCIETY. — St. Bede's College, Alexandra Park, was established by Dr. Vaughan, Bishop of Salford, some years ago, for the special purpose of giving a commercial education to youths who were to follow a commercial career. There are fifty boarders and twenty day pupils, few of whom seek to attain more than a moderate proficiency in Latin, but, on the other hand, every European language known to the commerce of the world is being taught. Commercial geography forms a chief subject of instruction, and on the afternoon of Saturday last a goodly number of the members of the Manchester Geographical Society visited the College, in order that an insight might be obtained of the manner and method of teaching adopted. The Rev. L. C. Casartelli, M.A., acted as leader round the museum, and gave a clear explanation of matters of interest. Mr. J. J. Cardwell, lecturer at the College and at the Harris Institute, Preston, in physiography and commercial geography, and also lecturer at the Manchester Technical School, set forth the character of the teaching. The Museum contains an epitome of the world's productions. Mr. Cardwell takes the boys every week into the museum, and entertains them by showing what different soils and varying climates give for the use of man. It is not as yet a complete museum, but all that is there is excellent. When the institution was founded, Dr. Casartelli visited different schools in Europe, and saw how far they were in advance of us in this particular matter of commercial geography. Every good school had its museum. At one school near Ghent he inquired of the master how his splendid collection had been made. The answer was that by industrious application the accumulation had gradually come. Dr. Casartelli went to work in the same way. He applied to the Commissioners of different countries represented at the Colonial and other London exhibitions, to the same people at the last Paris Exhibition, and to many private individuals, and the fruits of the perseverance of a dozen years are seen in the fine College collection. Broadly speaking, the museum has two sections. In the first there are certain specimens of the natural products and raw materials of commerce, and in the second a geographical collection illustrating chiefly some of our colonies. Thus, the first section includes seaweed tissues from Australia; spices, such as nutmeg, cassia, or bastard citron; tea and coffee plants; the South American orchid, used to flavour chocolate; dyeing woods and vegetables of all sorts from Brazil, the West Indies, Lima, the African coasts, and elsewhere; the "copal" resins, "clouded in African mystery both as regards sources of supply and trees that produce," and shipped from Accra and Lisbon; brewing materials; flax and linen cases, and very complete cotton cases. The colonial exhibits are not less interesting. Canada and Australia send the fruits of their soils. From West Africa are gums and rich spices, cotton from the silk cotton tree, ella (fruit of the doom palm), and so on. British Guinea supplies dried plantains, ochre, isinglass, cassava, molasses, rices, and the seed from which is produced castor oil. The ethnographical specimens, though small in number, include some striking objects. There is a fine collection of Indian and Italian moths, and the great insects from India are marvels of rich and varied colouring.

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LEEDS GEOLOGICAL ASSOCIATION. — At the annual meeting of this association the usual report of the year's work was submitted by the secretary. An abstract of the same proves that the association continues to advance in a most gratifying manner. A reference shows that the roll, which stood in 1884 at 30, and had gradually increased to 109 in 1888, now registers 130 members. There have been eight evening meetings, when lectures on different branches of geological science, generally accompanied by the lantern and illustrated by specimens, have been given. The field excursions have been as under:—

	District.	Leader.	Geology.
No. 1.	Knaresborough to Nidd Bridge	Mr. Holgate, F.G.S.	Permian.
No. 2.	Beeston and Batley Railway	Mr. W. Rowley, F.G.S.	Middle Coal Measures.
No. 3.	Robin Hood's Bay	Mr. W. H. Hudleston, F.R.S.	Oolite and Lias.
No. 4.	Market Weighton	Rev. E. M. Cole, M.A., F.G.S.	Lias and Cretaceous.
No. 5.	Garforth & Newthorpe	Mr. Holgate, F.G.S., and Mr. Burlend	Permian.
No. 6.	South Milford and Sherburn	Mr. Holgate, F.G.S.	Permian.
No. 7.	Brough and Elloughton	Mr. Holgate, F.G.S.	Tertiary Gravels and Oolites.
No. 8.	Giggleswick and Langcliffe	Mr. W. G. Perfect	Mountain Limestone.
No. 9.	Haddockstones and District	Rev. J. S. Tute, B.A.	Erratics, Permians and Third Grits.
No. 10.	Holme Valley	Mr. J. Field	Millstone Grits.

It will thus be seen that splendid facilities have been given to study, under accomplished and practical leaders, the geology of our unrivalled county. It is well to mention the series of Permian excursions, now being ably led by Mr. B. Holgate, F.G.S. Three of the series have been held during the last session. The fourth part of the *Transactions* was issued in the spring. The association has since the last annual meeting been admitted as a corresponding society of the British Association. The following gentlemen—Messrs. J. E. Bedford, F.G.S., B. Holgate, F.G.S., and Wm. Cheetham—have during the past year been appointed, on behalf of the association, to serve on the local committee for the purpose of making arrangements for the visit to Leeds in 1890 of the British Association. The Secretary (Mr. Adamson, F.G.S.) represented the association upon the general committee of the British Association at the Bath meeting. The election of the executive for the session 1889-90 took place, with the following result:—

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President, Mr. J. E. Bedford, F.G.S.; vice-presidents, Messrs. Bell, Cheetham, Hardcastle, and Holgate, F.G.S.; treasurer, Mr. W. H. Gill; librarian, Mr. C. Brownridge, F.G.S.; assistant secretary, Mr. A. E. Nichols; council, Messrs. Brownridge, Ingleby, Hawkesworth, Harris, and Carter; and secretary, Mr. S. A. Adamson, F.G.S.; Mr. J. W. Davis, F.G.S., was elected an honorary member.

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LEEDS GEOLOGICAL ASSOCIATION.—A paper was given at the May meeting of this Association by Mr. W. H. Fitton, entitled "One of Nature's Gems." Mr. Fitton, in discussing the question, "What is Coal?" referred to the controversy which raged some years ago upon the Torbane Hill coal. This was the subject of costly litigation, in which the evidence was most conflicting, and the case terminated without coming to a fair and clear understanding as to what is and what is not coal. The lecturer defined what coal is, saying it is a mixture of hydrogen, oxygen, nitrogen, and carbon in variable quantities with earthy impurities, and that it is composed of plant remains, which have perished at or very near the place where they grew, and which have been covered up and compressed, and by means of chemical action have passed through various intermediate stages until they have arrived at their present state. This chemical action was very minutely detailed, and the analyses of wood, humus, peat, lignite, brown, household, and steam coals, ending with anthracite, were given. Next was portrayed the appearance of this country during the Carboniferous period, the lecturer saying that probably the nearest existing parallel may be in the great swampy marshes in the deltas of the Ganges and the Brahmapootra, known as the Sunderbunds and the Jheels. Evidence of the changes caused by the decomposition of vegetation may be studied in the peat bogs of Ireland, where at the surface you can distinctly see vegetable structure; further down this gradually becomes indistinct, and the mass becomes darker and rather more solid, until it has the appearance, more or less, of coal. Professor Huxley, after studying the Low Moor Better Bed, is inclined to think that it is largely made up of spore cases of a vegetation allied to our present club mosses. These spores are very light, and are highly inflammable. As to the temperature of the time when our coal was formed, Daubeny was quoted, who says that it was about 62·5 Cent. He arrived at this result by taking the means of the extremes of heat and cold for the different families of plants, &c., that flourished in that period. The problem as to the duration of the coal period was briefly alluded to. Phillips assumes that one inch of carbonaceous matter is formed in 127½ years; other estimates, however, vary. Mr. Fitton divided this mineralised vegetable matter into peat, lignite, common coal, cannel, and anthracite. Peat arises from the decay of marshy ground, swamps, &c., and usually contains from 70 to 80 per cent. of water. An analysis of seven Irish peats gives—Carbon, 58·18; hydrogen, 5·96; oxygen, 31·21; nitrogen, 1·23; ash, 3·43; specific gravity, ·528. Lignite is wood-coal, or fossil wood, converted more or less into coal; it is a dull, dark brown in colour, burns with much smoke and dull flame, gives less heat, and is altogether poorer than house coal. It contains—Carbon, 67·4; hydrogen, 5·5; and oxygen and nitrogen, 27·1. Lignite is termed brown coal so soon as it loses, to outward appearance, its woody structure. The familiar common coal was next described. Cannel was probably formed in fresh-water lakes from vegetation that was carried down, became water-logged, sank, and was then covered up by other deposits. It contains fine specimens of fish remains, beautifully preserved. It is very compact and jet-like, breaks with a conchoidal fracture, and in splinters will burn like a candle; hence its name. An average cannel consists of—Carbon, 84·7; hydrogen, 6·4; oxygen and nitrogen, 8·9. Anthracite in burning developes great heat, and gives off no smoke, with very little flame; it is richer in carbon than any of the preceding. Thus the mean of 10 common coals gave—Carbon, 83·1; hydrogen, 5·3; oxygen and nitrogen, 11·2. Anthracite, however, was—Carbon, 95·2; hydrogen, 2·5; oxygen and nitrogen, 2·2. It has been supposed by many geologists that the change from ordinary coal to anthracite and probably to graphite has been caused by heat. It has been observed that where an igneous dyke runs against a seam of coal it often turns the coal into a cindery or sooty mass at the point of contact, but further away converts it into anthracite. For the shipping trade an item of very great importance is that of specific gravity. The following gives roughly an idea as to the relative weight of British coals:—Welsh, average 82lb. to a cubicfoot; Newcastle, 78; Derbyshire, Lancashire, and Yorkshire, 79; Scotch, 78; Irish anthracite, 99. The lecturer then referred to the eventual exhaustion of coal so far as this country is concerned. If, as one authority points out, the output advances at the rate of 40 per cent. each decade, as it has hitherto done, then we are rapidly exhausting our chief means of national wealth and power. The output mentioned above would at this increased ratio reach in 1936 to more than a thousand millions of tons annually. Some statistics were given to show the rate we are using up our coal, and he quoted Jevons, who says, "we are drawing more and more upon a capital which yields no annual interest; but once turned into light, heat, and force is gone for ever into space." The only way to delay the inevitable evil day is to economise its consumption, to develope appliances, to utilise every unit of heat the coal contains, and to avoid the waste of "getting" at the collieries.

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GEOLOGICAL SOCIETY OF LONDON.—At the meeting held on 19th June, several short communications were read. Mr. Frank Rutley dealt with the microscopic characters of certain thin tachylytic selvages occurring on the margins of white-whin (basalt) veins which traverse carboniferous shales in Victoria Park, Whiteinch, Glasgow. Mr. S. S. Buckman reviewed the history and literature of the genus of ammonites known as *Sonninia*, and gave reasons for the conclusion that the three genera *Pleuroceras*, *Amaltheus*, and *Sonninia* were descended from a common source, and that they form three branches from one stem. In a paper on "The Bagshot Beds and their Stratigraphy" Mr. H. G. Lyons gave the results of detailed work over the country between Aldershot and Ascot. In mapping the southern and eastern limits of the Upper Bagshot beds, he claimed a much greater extent for these beds than had been assigned by the Survey. The outcrop of the beds was described in some detail, and the occurrence of outliers on Knaphill Common, Chobham Common, and Staples Hill was noted. Miss Jane Donald, in a "communicated" paper, described some new species of carboniferous gasteropoda, collected by Mr. John Young from the Upper Limestone series of Scotland. Mr. J. W. Gregory recorded the discovery of a species of *Cystechinus* from the radiolarian marls of Barbadoes, which he ascribed to the Pliocene or Pleistocene period. The author concluded that, though *C. crassus* was an inhabitant of seas of less depth than those in which the modern forms occur, it may be fairly considered to have been a dweller in deep seas, and to indicate that the radiolarian deposit is a true deep-sea ooze.

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LIVERPOOL GEOLOGICAL ASSOCIATION.—The ordinary meeting of this association was held on 1st July, at the Free Library, the president, Mr. A. Norman Tate, in the chair. Several photographs, illustrating features noted during recent field-meetings, having been exhibited and described, the secretary read a communication from Mr. T. Mannington on a calcareous tufa occurring above the boulder clay near Flint, on the site of an old lake or marsh. Specimens of the tufa and associated peat were exhibited, and the chemical analysis of the material given. A brief address was then given by Mr. James Wilding on the sandstone of the Birkenhead Priory, and the styles of workmanship associated with it. By the help of drawings and some blocks of stone, Mr. Wilding was able to show how the different styles of stone dressing and wall construction had influenced the durability of the building, and how a knowledge of some of the methods adopted by the early English

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builders would prove of constant service to their representatives of the present day. The secretary, Mr. I. E. George, afterwards offered some remarks on the geology of the district about Ingleton.——A field-meeting of this association took place on the 8th July, at Storeton Quarries, where, through the courtesy of the proprietors, an opportunity was secured of noting the various points of interest which have been exposed from time to time during quarrying operations. The party was under the guidance of Mr. O. W. Jeffs, who has made a special study of the geology of Storeton. Near the old windmill, at the south quarry, Mr. Jeffs proceeded to demonstrate, with the aid of a diagram and a beautiful set of photographs, the structure of the hill, the position of the noted footprint bed, and the minor features connected with the numerous dislocations to which the rocks of Storeton have been at various times subjected. A search among the quarried blocks of sandstone soon revealed some slabs bearing a series of footprints, which were identified as those of a species of *rhyncosaurus*, a lizard-like animal, which frequented the shores of the Triassic lakes, and left its trail on the sandbanks. Other features observed during the evening included some polished surfaces associated with rock movement, two sections in which the junction of the two local divisions of the Trias was visible, a cutting in the new red marl, and a roadside section on the western side of the hill, in which the basement bed of the Keuper was seen.

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Manchester Microscopical Society.—The closing meeting for the session of the mounting section of the Manchester Microscopical Society partook of the nature of a *conversazione*, with an address on histology by Mr. E. P. Quinn. At the June meeting 56 slides, representing the work done in the course of the session, were presented to the society's cabinet by several members of the section and at this meeting the slides were exhibited. Mr. Quinn, in his address, reminded the members that the work taken up in the systematic histological course was a continuation of that of the previous year. Then they confined themselves to the examination and study of the vegetable and animal cell, and in the course of their work became acquainted with some of the more important of the vegetable structures. This year they had been engaged in the examination of animal tissues. A vegetable cell possesses a distinct wall differing from a protoplasmic contents, both chemically and optically, so that there was a strict line of demarcation between contiguous cells, and the tissues were clearly seen to be cell aggregates. But animal cells possessing no distinct walls frequently merged themselves into each other, so that the resulting tissue might be mistaken for a non-cellular substance if it were not for the presence of the more darkly stained nuclei. As example of this, Mr. Quinn cited the microscopic appearance of involuntary muscle fibre and capillary blood vessels. Moreover, the cells were laboratories, in which substances were formed that, extending beyond the limits of the cell, formed a matrix in which they became embedded; and, according to the greater or less development of this extra cellular matrix, very different appearances resulted, as shown by the examination of cartilage or gristle in its different stages of growth. In cartilage this matrix generally remained clear and homogeneous, but in other tissues it became variously modified, both structurally and chemically, so that its true cellular nature might be more or less hidden, as in the case of the various forms of fibrous or connective tissue in voluntary muscular fibre and also in bone. Mr. Quinn then referred to the importance of the study of slides prepared from the embryonic tissues, and to the necessity of the scientific use of stains and re-agents for the proper elucidation of the cellular nature of animal structures. He dilated upon the value of such systematic courses of work as they had undertaken, in order to become acquainted with the real structure of the different parts of animals and of plants, using the microscope as an adjunct to the study of the larger problems of biology, and thus making it not only minister to their pleasure, but also the means of an intellectual development. ——About forty members of the Society paid a visit to the Ship Canal Works, on 22nd June, under the guidance of Mr. Percy F. Kendall, F.G.S., Lecturer on Petrology at Owens College. The first point of interest after descending into the cutting was the presence of "cracks," or faults in the bed of sandstone. These faults, Mr. Kendall stated, were doubtless due to volcanic disturbances. The whole of this district bears evidence of having been at one time a salt lake, dipping towards a point midway between here and Liverpool. This idea is strengthened by the finding of numerous casts of salt crystals, the crystals having been deposited upon the evaporation of the brine, and afterwards becoming coated with mud. Further on the attention of some of the members was arrested by the appearance of streaks of blue matter in the upturned earth. Mr. Kendall gave it as his opinion that this was due to a mineral termed Vivianite. In order to settle the question a portion of it was handed to the honorary secretary (Mr. Hart) for analysis. This investigation proved the correctness of Mr. Kendall's theory. Vivianite is a form of phosphate of iron. It is often seen on bones that have been buried in a ferruginous earth. Its formula is $Fe_3 P_2 O_8 + 8H_2O$. The source of the phosphorus in this case is doubtless the sewage matter which had united with the iron present in such large quantities in the sandstone. Towards Barton, Mr. Kendall pointed out a large hollow in the rocks which had been worn in by the constant "swishing" of the waters, carrying along with them pebbles of various sizes, and thus gradually wearing away the softer rock. A search for the "pot hole" discovered in this locality was made, but it had evidently been destroyed in the progress of the works. These "pot holes" are extremely interesting. They are formed by the constant whirling around of several stones by an eddy of the river, thus forming a large round hole in the rock. Sometimes the larger hole contains a small one formed on its inner circumference. At Barton can be noticed the large heaps of dressed sandstone, ready for use in the construction of the canal, from which they were removed; and side by side with these may be seen huge blocks of Cornish granite and millstone grit, both ready dressed, and awaiting their use in the construction of the locks and docks. Passing on towards Stickins Eye, the site of the embedded canoe was pointed out. Various opinions as to the age of this relic were put forward. A little further on the artesian well was discovered. The character of the bricks, the fact that the depth is 260 feet and the bore about six inches, effectually silenced those who had a mania for prehistoric remains. Here also was a most curious "find." Embedded in the sand, with innumerable leaves, twigs, and hazel nuts, were strips of leather, varying in length from one inch to nine or twelve inches. Close to this spot was found some time age a wooden comb, which was claimed to be almost if not quite prehistoric.

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Manchester Association of Science and Art Teachers.—The annual meeting was held on Saturday, July 20th. In the afternoon a party of the members met at the Owens College, and were conducted through the galleries of the museum by Mr. J. Ray Hardy, the assistant curator. In the evening a meeting was held at the Manchester Technical School, Mr. John Angell, F.C.S., in the chair. Mr. J. H. Reynolds introduced the subject of the Technical Education Bill, explaining its objects and the way it endeavoured to achieve them. Mr. H. Stott gave a brief epitome of the changes in the new Directory of the Science and Art Department, one of which is important, namely, that the requirement for the twenty claimable attendances to be given under one committee is now omitted, thus probably enabling teachers to claim for pupils taught (owing to a variety of reasons) under more than one committee; among other changes is the fixing of the amount of grant towards apparatus at not less than £1,

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and that no article is to cost less than 5/-, both of which will press hardly on some schools. He called attention to the fact that prizes in second grade art had been withdrawn, and deplored this step. In the discussion which ensued, Mr. Stott's opinions were generally endorsed, and resolutions were passed in favour of Elementary Examinations in Light and Shade, and in favour of allowing pupils in Modelling, where the number is below the required minimum (10) for separate examination, to be examined at other schools. Attention was also directed to the very unsatisfactory manner in which the subject of Black Board Drawing for pupil teachers is provided for by the Department. Mr. Dickinson brought forward the subject of the Examinations in Geometry (Section 1) and Physiography. He said there was no doubt that the questions in these subjects were very unfair and went beyond the syllabus, and he thought that a protest should be entered against the two papers as being beyond the general attainments of candidates, as when examiners set questions quite outside the syllabus it was unfair, and tended to discourage students at the very outset, and make them feel that they must fail when you want to encourage them to think they will pass; the worst of it was that the students blame the teacher for not teaching them, whereas it is not his fault but that of the examiners. With regard to Geometry his opinion was that the Department want to do away with Art Geometry, and wish eventually to merge it into Plane and Solid Geometry. He thought the Department made a great mistake in making the examinations too stiff; they do not encourage students, but give them a distaste for further study, and, besides, it was a great discouragement to teachers who depended on the examinations for their remuneration. The discussion that ensued was taken part in by Messrs. Pillow, Harrap, Angell, and others, who generally endorsed the views of Mr. Dickinson. It was pointed out that the questions in physiography only covered a very small portion of the subject, and the opinion was expressed that this was most unfair; the questions set ought to cover the whole of the syllabus.

Reviews.

The Building of the British Isles: A Study in Geographical Evolution. By A. J. Jukes-Browne, B.A., F.G.S. [London: George Bell & Sons.]

The methods of geological teaching have undergone a great change within recent years. Not content with the stratigraphical data and minute mineralogical details of the rock-masses of the earth's crust which usually form the staple contents of the text-books, the modern geological student is required to familiarise himself with the physical aspect of the earth in past epochs, and with the nature of the changes which have brought about existing geographical conditions. In a word, geology must now be studied from a geographical standpoint, and thus these two sciences, usually kept apart, are now to be linked together in an indissoluble band. In a former work from the pen of Mr. A. J. Jukes-Browne (who is fast gaining a position as one of the ablest thinkers and writers on the staff of the Geological Survey), an attempt was made to give brief accounts of the physical and geographical changes which took place during each of the periods usually assigned to the geological record. These restorations were admittedly very incomplete, and in some instances required more detailed consideration of the data at hand for so difficult an investigation. Many geologists, notably Mr. Godwin-Austen and Professors Ramsay and Hull, have dealt, more or less fully, with the geographical conditions of past periods; but these dissertations have been of an experimental nature, and, so far as any results have been attained, they have only confirmed the belief that the material at present within our grasp is insufficient to enable us to form any accurate conclusions upon the subject. In the volume now under notice a more ambitious venture is made with the object of tracing out the geological history of the British Islands through the successive changes and conditions which have affected each group of strata. As stated in the preface, the work "does not deal with the rock-groups of which our islands consist, so much as with the physical conditions under which they were formed, the rocks themselves being described only so far as is necessary for ascertaining whence their component materials were derived, in order to form some conception of the relative position of land and water during each of the successive periods of geological time." It must at once be said that our author has performed his task with great ability. To grasp the intimate relations of the vast range of formations, so diverse in character, as are comprised within the rock-formations of the British Islands is an achievement of no light order. Mr. Jukes-Browne has produced a work which will be read with pleasure and profit by every geological student, and it is no reflection upon him if we say that he has failed to convince us that his hypothetical restorations of archaic geography are, in every case, to be regarded as anything more than ingenious speculations. The "scientific use of the imagination" is in no branch of knowledge more necessary than in geology. It is one thing, however, to show the origin of certain strata, whether fluviatile or marine, lacustrine or æolian, and another to lay down upon a map defined limits of the extent of land and sea at former periods. These limits, as laid down on Mr. Jukes-Browne's maps, may be true up to a certain point, but it must be remembered that, throughout all the ages, denudation has been in progress, the extent of which it is not always possible to calculate. After an explanatory introduction, the author describes the nature and origin of the rocks at each geological period, and gives a large amount of valuable information, the views of the chief workers in the geology of each period being stated. His conclusions are illustrated by a series of the maps to which we have referred. In these maps the outline of the British Islands is given in red, and the geographical area of the formations, as believed to have existed, is imprinted in blue, so that the relative areas covered by land and sea can be seen at a glance. At the end of the work a "summary of geographical evolution" is appended, together with a chapter on the theory of the permanence of continents and oceans. We have not space to refer, as we should like, to the many interesting facts and hypotheses brought out by our author, who has the happy facility of grasping and presenting to his readers in a graphic manner the substance of discoveries made by various geologists, together with many original observations of his own in relation to them. The work of other geologists is carefully collected, and due acknowledgment is given to the original authority. Studied on the lines laid down by our author, the science of geology becomes doubly interesting to the student of the earth's wonderful history. O. W. J.

Cosmic Evolution. By E. A. Ridsdale.
[London: H. K. Lewis, 136, Gower Street, W.C. 1889.]

This small octavo volume consists only of three chapters, together with an Introduction and an Appendix, being "speculations on the origin of our environment." The whole are included within 130 pages of large type, so that it will be apparent that the author has not allowed himself a great space to elaborate any new theory on the vexed questions connected with the evolution of our universe. The general principle, which it would seem it is the object of the present pamphlet to define, is thus crudely stated in the preface:—"All the bodies at present existent in the universe have, by a gradual evolution, or differentation under a fixed law acting during varying conditions, been wrought from one primordial form of matter. This form originally existed at a tremendously high temperature, and was endowed with a far greater chemical activity than any of its numerous descendants. The evolution was attended with a gradual loss of heat, increase of density, and diminution of chemical activity." The author thus traces an unbroken connection between the two branches of inorganic and organic evolution, and it will be seen he enters into the region of controversial speculation. Into this interesting debating-ground we have not space to follow him, but may say that there are many students of science to whom this *resumé* will be useful. The more prominent discoveries of ancient and modern science are deftly made use of, including the most recent "meteoric" theory of the universe, to which the author does not give credence. The subject is too vast to be satisfactorily dealt with in the small space of this little work.

Obituary.

Death of an Eminent Botanist.—The Hon. and Rev. John Townshend Boscawen died suddenly in London. He was the younger brother of Viscount Falmouth, and was rector of Lamorran, Probus,

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Cornwall, since 1849, where (says the *Times*) he transformed a dreary waste into one of the most beautiful gardens in the West of England. He was one of the best living botanists, and for many years collected together fine exhibitions of plants in the Horticultural Department of the Bath and West of England Society. At one meeting of the Horticultural Society in London he beat all the professional exhibitors in orchids and rhododendrons. He established a great reputation for landscape gardening.

Miss Maria Mitchell, LL.D., a well-known astronomer in America, has just died in New York, aged 71. In early life she developed extraordinary talents, and assisted her father, William Mitchell, astronomer, in his work. She also made careful original observations, and devoted some time to the examination of nebulæ and the search for comets. In 1847 she discovered a comet, for which she received a gold medal from the King of Denmark. In 1858 she visited Europe and inspected the chief observatories of Great Britain and the Continent. She was appointed Professor of Astronomy at Vassar in 1865, which position she retained until the beginning of last year. The degree of LL.D. was conferred upon her by Hanover College in 1852, and by Columbia College in 1887. She was the first woman to be elected to the American Academy of Arts and Sciences.

Sir James A. Picton, F.S.A.—The death of this well-known antiquary, "the historian of Liverpool," took place suddenly at his residence at Sandyknowe, Wavertree, on the 15th July, at the age of 84 years. As a municipal representative he had long laboured for the welfare of his fellow citizens, and will be always remembered in connection with the Free Library movement. Several public buildings in Liverpool bear record to his skill as an architect. His literary and scientific work comprised the *Memorials of Liverpool*, and a collation of the Municipal Archives of the city, in which he rescued from oblivion many valuable historic documents. He was a member and frequent contributor of papers to the local learned societies, and wrote several articles on municipal institutions for the *Contemporary Review*. He displayed great interest in archæological inquiry, presiding over the Liverpool Congress of the British Archæological Association in 1887. He received the honour of knighthood in 1881 in recognition of his eminent services in literature and art.

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Letters to the Editor.

Notice to Correspondents.

It is important that Letters to the Editor should be as brief as possible and to the point, as it is difficult to find space for lengthy communications.

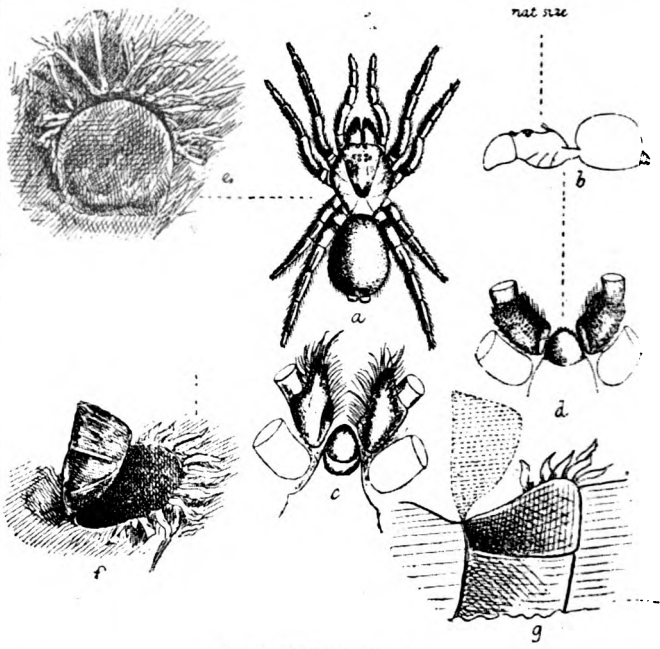
New Species of Spiders.

Sir,—Referring to my letter on "New Free Trap Door Spider," published in your issue for May last, I would now say that I had hoped that the engraving of the spider, *dendricon rastratum* (O. P. Cambridge), would have been ready for your June number, but I find it is not likely to be printed before October next, consequently I must beg your readers to have a little more patience. In the meantime I have much pleasure in furnishing you, from the *Proceedings of the Zoological Society* of London (paper read February 19th, 1889, by the Rev. O. P. Cambridge), with a description and drawings of two new species of spiders that I have recently presented to the Free Museum Collection of Liverpool, which are exceedingly interesting. One belongs to the genus *moggridgea* (O. P. Cambridge), from Graham's Town, South Africa, and the other one to the genus *idiops Colletti*, from Upper Burmah, near Meiktala, India, and shall feel obliged if you will publish the same in your next number of *Research*.

Fredk. Taylor.

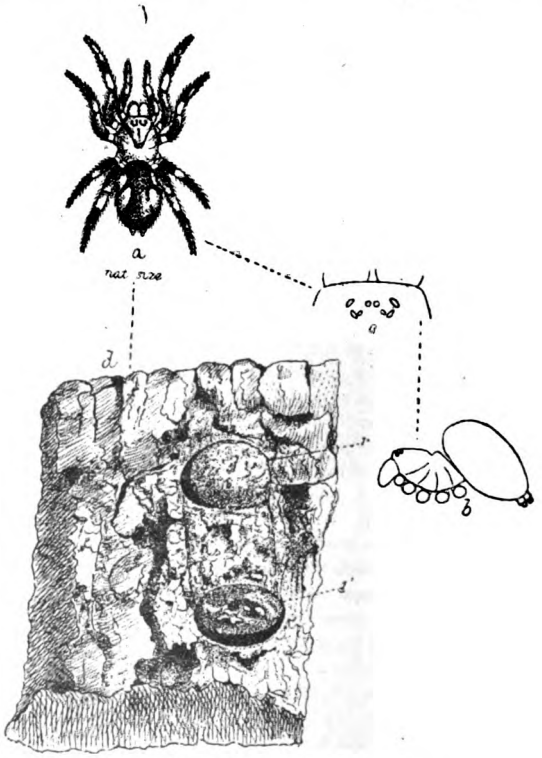
[Mr. Taylor mentions that the box containing the spiders from Col. Collette were received during his absence, and carefully placed in his wine cellar as a case of champagne!!—Ed.]

The following are the drawings referred to by Mr. Taylor, which are taken by permission of the Zoological Society, by the Rev. O. P. Cambridge, from the *Proceedings of the Zoological Society*, part 1, 1889, page 34 :—



Idiops Colletti, sp. n. ♀.

a, Spider, natural size. *b*, Profile, without legs, &c. *c*, Eyes, from above and behind. *d*, Maxillæ and labium. *e*, Entrance to nest. *f*, Ditto, with trap-door raised. *g*, Section of upper part of nest.



Moggridgea Alrahami, sp. n. ♀.

a, Spider, natural size. *b*, Profile, without legs, &c. *c*, Eyes, from above and behind. *d*, Portion of bark of "Kaffir boom" tree, with nest, showing (1) upper hinged lid (1') lower ditto, both slightly open.

Errata.—Museum Notes.—In the note on Warwick Museum in our last issue, for caldyodon read *cladyodon*, for kuperines read *kuperinus*, for superses read *superstes*, and for boltzia read *voltzia*.

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Research:

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NOTICES.

Cases for Binding Vol. I., Price 2/-, or by post 2/3, may be obtained on application to Mr. E. O. Windel, 9, Hackin's Hey, Liverpool.

Bound Volumes, Price 5/-, or by post 5/6, can be obtained from Booksellers and News Agents, or from any of the Publishers. (Only a small number of Volumes remain unsold.)

Articles on "Influence of Forests on Climate," "Artificial Light Photography," "Life Zones of the British Lias," "Pathology of Plant Life," "Buried Toads," and "Trap-door Spiders;" "Notes on Natural Resemblances," and several other communications, reviews, &c., are in type, but we have not spa e for their insertion in this number.

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E. W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & Co. Price 3d., or by post, 4d. Annual Subscription 3s., or by post, 4s.

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Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the followlng numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Enumeration of Germs in Water.

BY DR. MCPHERSON, F.R.S.E.

IN a recent number we gave an account of the enumeration of organic and inorganic particles in the air. In this paper we will deal with the organisms found in water and sewage. Twenty years ago Dr. Burdon-Sanderson showed by direct experiment that most water contained bacteria of some kind; and, during the last few years, methods for their detection and enumeration have been described by Koch, Klein, De Bary, Angus Smith, Warden, Percy Frankland, and others; and, in illustration of what is now being done in this direction, we will state the results of two interesting sets of experiments lately made in London and Glasgow.

Mr. A. W. Blyth, a public analyst in London, adopted the following method to count the microbes in water:—He melted nutrient gelatine (for the cultivation of the germs), and poured a quantity into an enclosed division of a glass plate (four inches by four inches). A drop of the water to be examined is mixed up with this gelatine, the whole being about one-tenth of an inch in thickness. To make the counting easier, the plate is divided into 16 small squares. When sewage is being examined, a drop of the sewage is placed among a thousand drops of distilled water (free from germs), and a drop of the mixture is used for the experiment.

It was found after a few days that the colonies were quite visible, and could be counted. A drop of the London sewage, taken in June, was diluted a thousandfold, and a drop of the mixture subjected to cultivation. On each square 10 colonies (on an average) were counted. That gives 160 to the diluted drop, and 160,000 to the drop of sewage. In July, three times that number were counted; in November, about half the quantity found in June. This shows that the sewage is considerably influenced by the season. These colonies he found to be of all kinds of fungi, more especially aspergilli, bacteria, bacilli, and micrococci.

In a drop of water from a pond in which ducks and geese were regularly swimming, but which received no drainage, he counted 153 colonies; from an open well, 400 colonies in a drop of the water; in the Regent's canal, a drop of water taken a foot below the surface produced 1,400 germs; whilst, just above the mud in the same canal, a sample gave 22,540 colonies per drop.

The remarkable fact was discovered that in canals and rivers the micro-organisms slowly subside. The water of the Thames yielded 500 colonies per drop near the surface, and 2,750 colonies per drop close to the bottom. At Sunbury, he found in a sample, which was taken above some black mud, no less than 280,000 colonies per drop. But, in the sea water round the south coast of England, the organisms are more numerous near the surface. Samples taken off the old pier at Brighton, in July, were found to yield 730 colonies per drop on the surface, and only 10 at the bottom. The water supplied to London by the Middlesex and Grand Junction Companies varied in purity according to the season. In May a drop contained 7 germs; in July, 45; and in November, 3. These are remarkable facts.

Dr. Maylard has, by a slightly-different process tested the waters at Glasgow. A properly-sterilised stoppered tube is taken, and into it is placed a small quantity of Koch's jelly. This is again sterilised and

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kept for a week in order to test its absolute purity. In proceeding to make use of it four drops of the water to be examined are inserted into this jelly, previously liquefied. It is gently shaken to make sure that the water is well dispersed through the jelly. The tube is now held almost horizontally, and rotated rapidly round its long axis beneath a constant stream of cold water. This cooling process causes the jelly to congeal and adhere to the sides of the tube, until it finally solidifies as a thin film lining the inner surface of the tube. The tube so prepared is laid aside and watched day by day. Sooner or later visible colonies appear, and these can be counted in the divisions scratched on the glass.

In the Transactions of the Philosophical Society of Glasgow are found the results of Dr. Maylard's observations. He took the water generally used in the town—Loch Katrine water—as it flowed from the tap in his laboratory. Four drops were experimented upon in a glass tube, and in four days six colonies made their appearance, but on the average one or two colonies were found in a drop, though sometimes he counted four. This yields about 300 per cubic inch. A small tumbler, two inches in diameter, with four inches deep of water, would on this average contain 3,750 organisms. One can scarcely conceive that he swallows about a thousand organisms with every mouthful of water.

However, to relieve one's mind of any unpleasant feeling about the consumption of so many microbes, we have only to look at the number found in the Clyde water. He took the sample from mid-stream about opposite Govan Pier. Experimenting with the same quantity as before, he found that the number was totally beyond the power of human calculation. The jelly, too, putrified to such an extent as to be quite offensive on removal of the wool stopper. Accordingly he used diluted samples, and found no fewer than 1,500 colonies in the original drop, or 425,000 in the cubic inch. But, what is more startling still, when the Clyde water (of the same sample) was allowed to lie stagnant for twenty-four hours before being experimented upon, no fewer than 14,280,000 microbes were counted in a cubic inch, or upwards of 50,000 in a drop. No wonder that one feels a very disagreeable smell when sailing down the Clyde in summer weather!

Dr. Maylard's attention was next directed to the report of the Government Inspector upon the pollution of Lochs Long and Goil in the neighbourhood. He took samples at three places—one from Loch Goil, close to the pier at Carrick Castle; a second from mid-stream, at the entrance of Loch Goil; and a third at the entrance of Loch Long. In a cubic inch of the first sample he found 354 microbes; in that of the second, 142; but in that of the third, no fewer than 35,400 microbes.

Now, what is the nature of these germs? They are generally accepted as belonging to the vegetable kingdom. Under the microscope they appear in the form of round or rod-shaped cells, the former being micrococci and the latter bacilli. The diameter of one of these cells is not more than the 25-thousandth of an inch. They multiply by fission and the formation of spores. So prolific are they that under conditions of suitable soil and temperature they will, in a very short time, increase a millionfold; and according to Klein, they grow best when left undisturbed. Cohn and Mendelssohn consider that strong electric currents have a noxious influence on their growth. Pasteur distinguishes between those that require free access to oxygen and those that can do without it. Some can live in a cold of 5° Fahr., and up to a heat of 200° Fahr. No spores survive above 248° Fahr.

Dr. Maylard gives us, however, some comfort about the innocuous character of most of these bacteria. We have often been told that all these organisms are necessarily injurious to man or beast. But he has been able to prove that the majority are perfectly harmless; and some are even food for animals. A tumbler of turbid water, with its millions of harmless germs, might be relatively as nutritious as a basin of soup. As an uncultivated field contains numerous species of plants, the majority of which would prove, as food, quite harmless, though a few, when eaten, might be dangerous or even fatal in the results, so with these minute organisms which throng the water—most are harmless, and a few are injurious when admitted into the animal system. The two sets grow together—the innocuous and the injurious—and the same soil is equally suitable for both. The harmless *micrococcus prodigiosus* and the deadly *anthrax bacillus* can both be cultivated most effectively on the same jelly or potato.

The existence of a large number of bacteria means the co-existence of a proportionately large quantity of organic matter. And as in the uncultivated field a few poisonous plants spring up among the large quantity of feeding or harmless weeds, so in an abundant organic soil a few deadly microbes will propagate among the myriads of harmless germs.

If, as a bacteriologist, Dr. Maylard were asked to express in as simple and practical terms as possible the conditions which, in domestic hygiene, would lead him to believe as the most suitable for the growth and propagation of bacteria, he would say ill-ventilated, overheated, crowded, filthy apartments. Now bacteria and certain diseases are as inseparably associated as water and steam; ventilation, therefore, and cleanliness are absolutely indispensable for keeping under disease. Drinking-water should be filtered, and if possible distilled and cooled; but every precaution ought to be taken to keep out sewage from any water which is used for domestic purposes. So tenacious of life are the germs, that greater hopes are entertained for the prevention of disease by excluding them than by destroying them. And the vast, almost inconceivable, number which are found in sewage should well alarm us, and force us to take any precaution to keep that from the water which we consume. When such noble efforts are being made to introduce germicides with the blood, so as to destroy the deadly bacilli without injury to the frame, every effort ought to be made to prevent the introduction of such death-bearing germs into the system at all. This is to be the more observed when we consider their vast numbers and prolific propagation, in the light of the assertion of the famous De Bary, that "a large part of the disease in the world is dependent on bacteria."

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The Evolution of the Grand Cañon of the Colorado.

A Problem in Physiographical Geology.*

By W. Hewitt, B.Sc.

Part III.

IV.—At what age (geologically) did the main part of the erosion occur?

It was pointed out above that Captain Dutton considers that the Grand Cañon district, which has now for its surface the platform of Carboniferous beds, was previously covered by Mesozoic and lower Eocene strata, corresponding to those seen in section in the Terraces. His arguments are—(1) that the strata could not originally have ended abruptly as they do at present, but must be projected in imagination to some logical shore line of deposition, which he gives reason for believing would be found at the junction of the Grand Cañon district on the west with the sierra Archean province, and by reference to the gradual thinning out of the beds eastward he shows that the sediment must have been derived from the west. (2). Some of the missing strata are represented in the district by outliers, in which the beds present the same characteristics as in the Terrace regions. (3). He also shows that the displacements by the great faults and the drainage system can be consistently explained only by the assumption that something like 10,000 feet of strata have been removed since they originated.

The Mesozoic formations were laid down with great regularity to a thickness of nearly 10,000 feet, but there is every evidence in the

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shape of cross-bedding, ripple marks, coal beds, &c., that the surface of deposition was mountained very nearly at sea level—subsidence proceeding *pari passu* with deposition. The Cretaceous beds are all lignitic and coal-bearing, and the latest beds of this age show signs of brackish water. At the close of the Cretaceous epoch important disturbances occurred. and soon after the commencement of the Eocene the waters became quite fresh, and so remained until they disappeared. The great Eocene lake seems to have dried up from south to north, the outlet of its waters being along the Colorado into the Pacific.

Since the lower Eocene beds form the highest scarp of the Terraces, the upheaval of the district must have taken place since that period. This fixes a limit in one direction.

The great denudation commenced at once and proceeded throughout later Eocene and Miocene times. These were in this district quite humid periods—as is shown by lake deposits of this age in neighbouring regions abounding in remains of large-sized mammals and abundant vegetation—and numerous tributaries of the main river would exist and aid in the work of denudation.

But by the time the river began to cut into the Carboniferous strata an arid climate commenced and nearly all the tributaries disappeared, some of them struggling on until they had cut their channels from 100 to 300 feet into the Carboniferous beds. Now there is evidence in adjacent districts in the shape of deposits in salt lakes that the Pliocene was a dry period, so that we can fix the completion of the great denudation and the commencement of the excavation of the outer gorge about the close of the Miocene epoch.

By the aid of the diagram (*fig.* 3) we can briefly summarise the history of the present configuration of the Grand Cañon district, as follows:—At the close of the lower Eocene epoch the sea level was approximately at the line *a b*, and the beds up to and including the lower Eocene extended over the whole district (as shown by the dotted

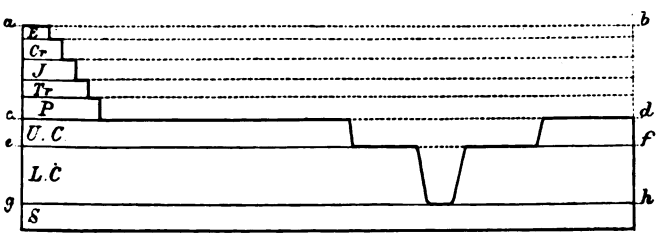

Fig. 3. Present configuration (diagrammatic) of Grand Cañon District.
E Eocene (Lower). CR = Cretaceous. J = Jurassic. TR = Triassic. P Permian.
UC = Upper Carboniferous. LC = Lower Carboniferous. S = Silurian.

lines). Upheaval of the land at once took, place until the base level of the river was brought approximately to *c d*. At this horizon the land remained stationary, probably until the close of the Miocene epoch, and during this period the beds down to *c d* (the summit of the Carboniferous) were removed by the river and its numerous tributaries and the weathering agents, leaving the Terraces as the scarped edges of the beds. The great Carboniferous platform, thus almost completely bared, was, however, about the beginning of the Pliocene, elevated to the extent of about 2,000 feet, the base level being then at *e f*. Here, again, a pause occurred, and the outer gorge of the cañon was formed. Finally, in more recent times, an uplift to the extent of about 4,000 feet occurred, and the result has been the scouring out of the inner gorge nearly down to the existing base level of the river *g h*.

V.—Before stating serially the special conditions necessary to the production of such a topographical phenomenon as the Grand Cañon in its present state, let us endeavour, by the aid of Captain Dutton's graphic and eloquent description, to realise the leading features of the scene.

"The Grand Cañon of the Colorado," he says, "is a great innovation in modern ideas of scenery and in our conceptions of the grandeur, beauty, and power of nature. As with all great innovations, it is not to be comprehended in a day, or a week, nor even in a month. It must be dwelt upon and studied. . . . . Those who have long and carefully studied the Grand Cañon of the Colorado do not hesitate for a moment to pronounce it by far the most sublime of all earthly spectacles. If its sublimity consisted only in its dimensions it could be sufficiently set forth in a single sentence. It is more than 200 miles long, from five to twelve miles wide, and from 5,000 to 6,000 feet deep. There are in the world valleys which are longer, and a few which are deeper. . . . . Still, the Grand Cañon is the sublimest thing on earth. It is so not alone by virtue of its magnitudes, but by virtue of the whole—its *ensemble*. . . . . The common notion of a cañon is that of a deep, narrow gash in the earth, with nearly vertical walls, like a great and neatly-cut trench. There are hundreds of chasms in the Plateau country which answer very well to this notion. . . . . Yet, the contrast between Saint Marc's and the rude dwelling of the frontiersman is not greater than that between the chasm of the Colorado and the trenches in the rocks which answer to the ordinary conception of a cañon. . . . . To the conception of its vast proportions must be added some notion of its intricate plan, the nobility of its architecture, its colossal buttes, its wealth of ornamentation, the splendour of its colours, and its wonderful atmosphere. . . . . Unquestionably, the great, the over-ruling feature" [in the view from one of the projecting points on the upper wall in the Kanab division, named by Captain Dutton Point Sublime] "is the wall on the opposite side of the gulf. Can mortal fancy create a picture of a mural front a mile in height, seven to ten miles distant, and receding into space indefinitely in either direction? As the mind tries to realise its proportions its spirit is broken and its imagination is completely crushed. If the wall were simple in its character, if it were only blank and sheer, some rest might be found in contemplating it; but it is full of diversity, and eloquent with grand suggestions. It is deeply recessed by alcoves and amphitheatres receding far into the plateau beyond, and usually disclosing only the portals by which they open into the main chasm. Between them the promontories jut out, ending in magnificent gables, with sharp, mitred angles. Thus, the wall rambles in and out turning numberless corners. Many of the angles are acute, and descend as sharp spurs like the forward edge of a ploughshare. . . . . At many points the profile of the façade is thrown into view by the change of trend, and its complex character is fully revealed. . . . . A series of many ledges and slopes, like a molded plinth, in which every stratum is disclosed as a line or course of masonry. . . . Numerous detached masses are also seen flanking the ends of the long promontories. These buttes are of gigantic proportions, and yet, so overwhelming is the effect of the wall against which they are projected, that they seem insignificant in mass, and the observer is often deluded by them, failing to perceive that they are really detached from the wall and perhaps separated from it by an interval of a mile or two. . . . A little, and only a little, less impressive than the great wall across the chasm are the buttes upon this side. . . . . Upon their flanks and entablatures the decoration peculiar to the formation out of which they have been carved is most strongly portrayed, and the profiles are most sharply cut. . . . . The ledges are vertical, the summits are horizontal, and the taluses are segments of hyperbolas, of long curvature and concave upwards. . . . . The horizontal lines or courses are equally strong. These are the edges of the strata. . . . . It is readily apparent, therefore, that the effect of these profiles and horizontal courses so persistent in their character is highly architectural.

"At the foot of the palisade is a platform through which meanders the inner gorge, in whose dark and sombre depths flows the river. . . . . Perhaps a half-mile of the river is disclosed. A pale dirty red, without glimmer or sheen, a motionless surface, a small featureless spot, enclosed in the dark shade of the granite, is all of it that is

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here visible. Yet we know it is a large river, 150 yards wide, with a headlong torrent foaming and plunging over rocky rapids."

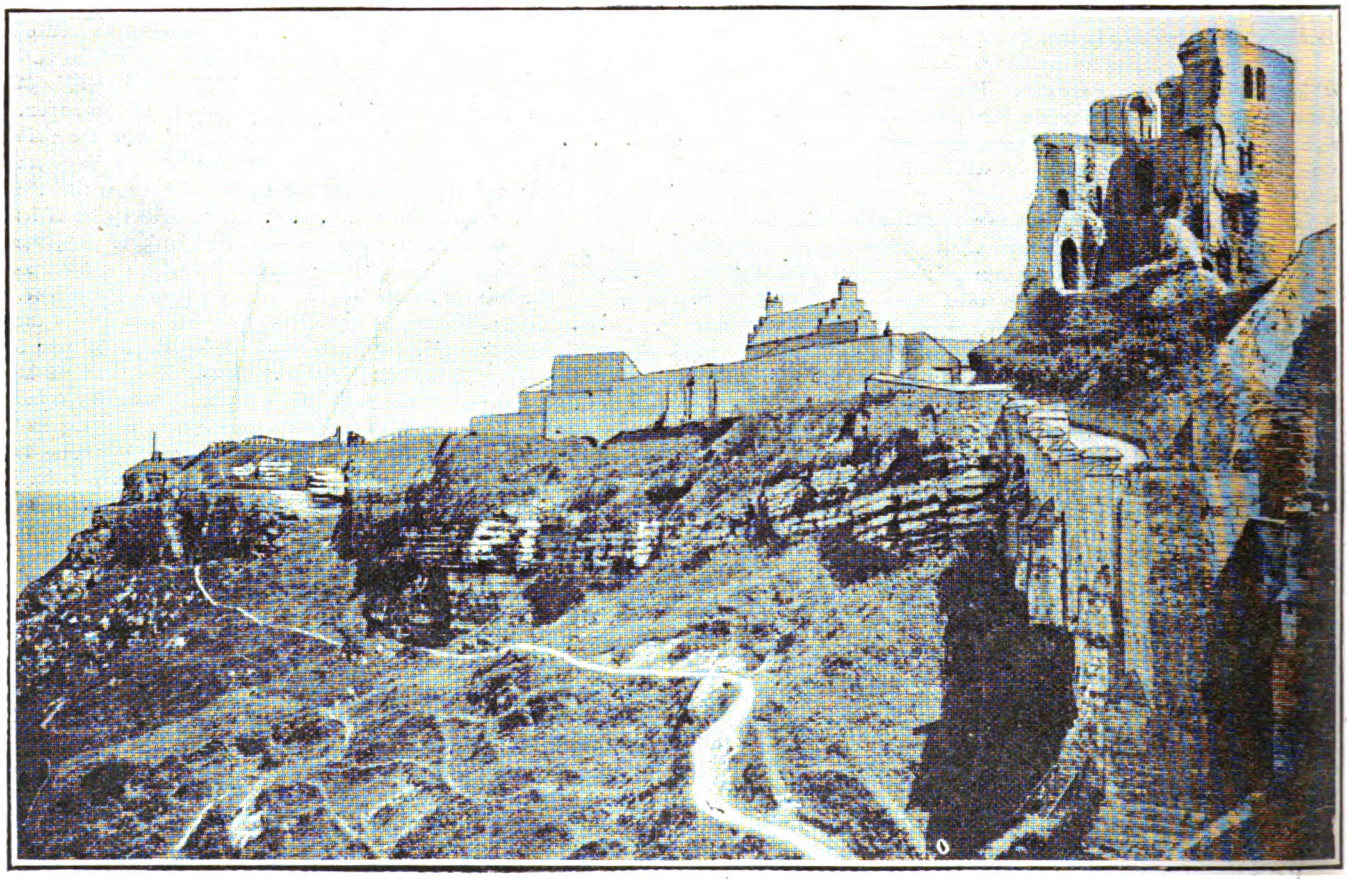
The conditions necessary for the production of such a topographical feature as the Grand Cañon, with its characteristic horizontal and vertical outlines and its marvellous architectural sculpture, are stated to be—

(a). A great elevation of the district, so that the streams can corrade deeply and produce high relief.

(b). Horizontality of strata to give the long flat crest lines and general wall like profiles to the cliffs.

(c). A series of strata, containing very massive beds, differing greatly among themselves as regards power of resistance to weathering, but each member or subordinate group being quite homogeneous in all its horizontal extent. Each hard bed, then, forms a vertical ledge, whilst the talus which covers and partly protects the intermediate softer beds has a more or less curved profile.

(d). An arid climate which, according to Gilbert's analysis, gives rise in a high country to a scanty soil, a diminished rate of weathering, and a great efficiency of transportation.



Scarborough Castle. *(From Photograph by Valentine & Sons, Dundee).*

Scientific Aspects of Health Resorts.

V.—The Geology of Scarborough and District.

At the mention of the word "Scarborough" what pleasing memories arise, stretching far away into boyhood, when it was associated with smooth sands, rippling waves, and long holidays! Yet the Scarborough of to-day far excels that of the past; its fine hotels, New Spa Saloon, extensive promenades, and the North Cliff improvements all testify that the good old town is determined to uphold its supremacy and distance newer competitors. The "Brighton of the North" is as popular as ever, and crowds of happy tourists bent on renewing their health, or surveying the natural beauties of the district, meet one continually. Much of the popularity of Scarborough is due to its unrivalled position, the houses rising tier above tier like an amphitheatre, and above all rises the timeworn and battered Castle, with its memories of battle and siege, from the time when Harold Hardrada, on his way to meet Harold of England at Stamford Bridge, amused himself by throwing lighted brands from the Castle Hill into the burghers' houses below. And, apart from its interest to the pleasure seeker or the antiquarian, the district is rich to the geologist, and is indeed classic ground; for have not William Smith, John Phillips, John Williamson, and others equally assiduous laboured here, and by their perseverance and application handed down to us a rich store of experience and results. The Museum near the Cliff Bridge is an enduring monument of the labours of those pioneers in geology just named, and the student, after examining the fine sections along the coast, may here add to his knowledge by careful study of the typical specimens which so well represent the local geology. It is a great help to the fossil collector, in determining his specimens, to have the aid of a collection like this at Scarborough.

The Castle Cliff, or Scar, which gives its name to the town below, is such a prominent feature and landmark for miles along the coast that a brief allusion to it is necessary. It is really an outlier cut off from the

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mainland by a couple of faults, which cross the neck of land on which the Castle is built It will be remembered that William Smith first discovered these faults, and his eagerness upon the occasion caused him to overstrain himself, from which he, however, recovered. The Castle Hill presents a fine section of the Lower Calcareous Grit. A general section of the hill on the north side, in descending order, is as follows:—Soil, drift and rubble, 10 feet; Coralline Oolite, 24 feet; Passage Beds, 28 feet; Lower Calcareous Grit, 66 feet; Oxford Clay, 135 feet; and Kellaway's Rock, 8 feet only visible. Total, 271 feet. Hudleston says "nearly the whole of the Middle Oolites may be seen in this fine precipice." The ferruginous sandstone which one sees just above the pier is the Kellaway's Rock, and the other beds named above can be seen in their order.

too, on the Brigg are those ramifying forms in the hard grit, which have occasioned such speculation and inquiry! The best explanation of them is by Hudleston, who says:—"It seems probable that they represent an organic body of prolate growth, which ramified freely in the accumulating sandy and calcareous sediment; weathering has brought them into relief." Scrambling round the Naze we get into those romantic coves or "doodles," and on the way a large series of beds, not seen on the Brigg itself, are well exposed. Pursuing our way to Scarborough along the edge of the cliffs we come presently to Gristhorpe Bay, with the cliff of that name at the south end of the bay and Red Cliff at the northern extremity. These cliffs are nearly 300 feet in height, and we find that the rocks which form Filey Brigg ascend to the top of Gristhorpe Cliff. This is a famous hunting ground for fossils, and plentiful

CLIFFS AT FILEY. *(From Photograph by Valentine & Sons, Dundee).*

The whole district, however, presents unexampled attractions and facilities to the geologist. Let us drop down to the quiet little town of Filey, some eight miles further down the coast, and make a few observations. This charming place is well adapted for the student and the scientist, who may meditate here at will without interference from the gaieties and the pleasures of Scarborough. Walking at the base of these flat-topped cliffs of Boulder Clay, which display the effects of weathering so characteristically, we note appearing from beneath the drift some beds of the Coralline Oolite. We continue our walk, using freely the hammer and chisel as we proceed, to that rocky reef or splendid natural breakwater of the Middle Calcareous Grit known so well as Filey Brigg. Here the naturalist as well as the geologist may find ample employment, as in the charming rocky pools which are so frequent the treasures of the sea may be found in vast numbers. How curious, have been the harvests here, particularly to the palæo-botanists, from the celebrated plant bed. Red Cliff shows a splendid section capped by Calcareous Grit, succeeded by Oxford Clay, Kellaway's Rock, and Cornbrash. This bay is one of the most interesting in many ways along the coast, and presents work enough for the most ardent geologist. There are two more small bays before we again reach Scarborough—Cayton Bay, where the Scarborough Waterworks are, and Carnelian Bay, where one may still find searchers for the jaspers and agates amongst the pebbles. The bold escarpment of Calcareous Grit, known as Oliver's Mount, overlooking Scarborough, has long been prominent to our view, and if our stay at the coast has invigorated us enough to ascend to its summit we shall be amply repaid by the far-stretching and magnificent views of sea and land. The fine escarpments to be seen will at once attract notice. These, which add much to the beauty of the

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FILEY NAZE.

(From Photograph by Valentine & Sons, Dundee).

scenery, are entirely due to weathering. The summit of the hills is composed of the hard Lower Calcareous Grit. This resists the various denuding agencies so well known to geologists, and stands out like a huge battlement. The strata below, being of the softer Oxford Clay, have succumbed and are seen as swelling slopes beneath, till we come again in many places to another terrace of hard rock, the Kellaway's. These nabs or escarpments just alluded to are known from their conformation as the Tabular Hills. A short walk inland from this point would bring us to Seamer, worth well all the trouble to see the famous boulder of Shap Fell granite found in some neighbouring gravels, and now carefully preserved in the garden of the enlightened station master. This boulder is one of the most interesting in Yorkshire, as it is the only boulder of this granite in the district whose position in the beds is exactly known. At Seamer, too, we are at the entrance to the great Vale of Pickering, whose smiling appearance must have impressed us on our journey by rail to Scarborough. This valley is composed of Kimeridge Clay, now overlaid by glacial and post glacial deposits, through which the Derwent winds its tortuous course on its way to Malton. At the base of the hills which guard the valley on each side we must have noticed also the string of quiet, pleasant villages, with their church spires rising above the trees. These villages well illustrate the influence geology has had upon man in selecting his habitation, for at these places beautiful springs discharge themselves from the Oolitic Tabular Hills on the north side and the Chalk Wolds on the southern.

Another popular inland excursion from Scarborough (it is by far the best to walk it) is to the beautiful Forge Valley, carved out of the Oolitic rocks by the tiny Derwent, and rich in many ways. Whether we consider its ecclesiastical and antiquarian lore, its relics of the ancient industry of iron smelting, its great geological interest, or its fine woodland scenery, all claim our deep attention and a careful visit. The cliffs to the north of Scarborough are low and irregular until we pass Cloughton Wyke and the pretty little glen of Haiburn Wyke, and arrive at the

IN FORGE VALLEY.

(From Photograph by Valentine & Sons, Dundee).

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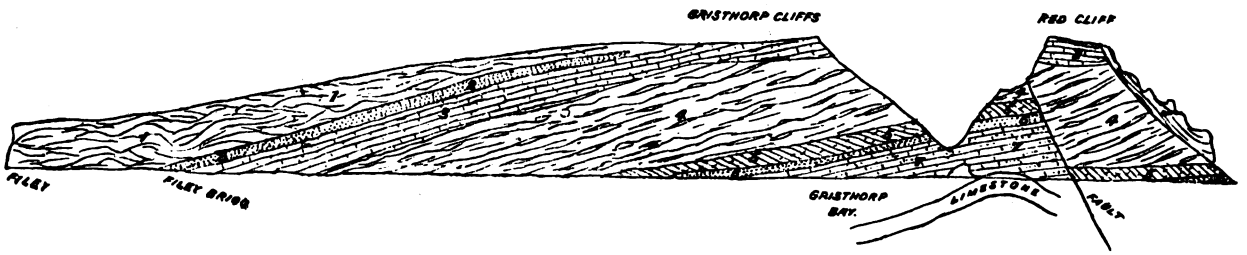
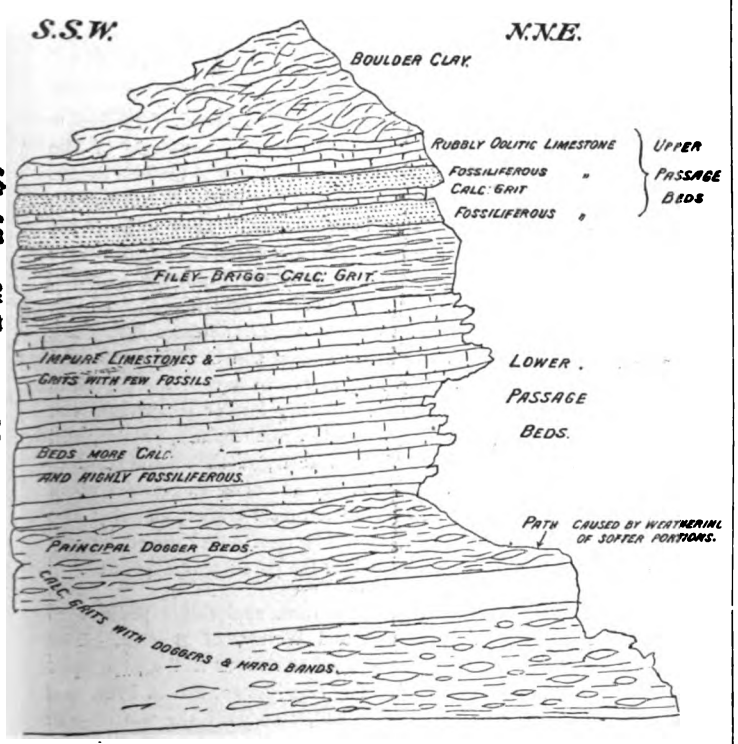
SECTION—FILEY TO RED CLIFF.



After Phillips.

1 Drift. 2. Coralline Oolite. 3. Calcareous Grit. 4. Oxford Clay. 5. Kellaway's Rock. 6. Cornbrash. 7. Upper Strata and Sandstone.

SECTION ACROSS PART OF THE CARR NAZE, FILEY BRIGG.



After Hudleston.

long and lofty range of the Staintondale Cliffs, which sweep up at the north end to a height of 585 feet. Below these imposing cliffs is a remarkable undercliff caused by an extensive slip, but, as Phillips says, "few besides zealous geologists care to traverse its labyrinthine paths'

Enough has been said without entering into more detail than this sketch will allow to show the splendid facilities afforded by Scarborough and district for carrying on successfully scientific observations and studying carefully the various beds of the Lower and Middle Oolites. Those geologists wishing more detailed information of sections and lists of fossils are recommended to obtain *The Geology of the Oolitic Rocks South of Scarborough* (1/-), by C. Fox Strangways, F.G.S., one of the memoirs of the Geological Survey, being an explanation of quarter-sheets 95 S.W. and 95 S.E. of the one-inch Geological Survey Map of England. The maps just named form an invaluable adjunct to this excellent memoir. Phillips' *Yorkshire Coast* and Hudleston's *Yorkshire Oolites* are also brimfull of information respecting this fine district.

S. A. A.

Notes in Brief.

THIS is the season of congresses. In Vienna a great Anthropological Congress has been successfully held, the chief excitement of which was the renewed attack of Herr Bötticher upon the discoveries of Dr. Schliemann, at Hissarlik (Troy). Archæologists will chiefly sympathise with the learned doctor, whose researches have thrown a flood of light upon many questions of Eastern Archæology.

AT Paris, during the "Exhibition period," several congresses on a great diversity of subjects have been held. One of the most practical of these was the Congress on Hygiene. The subjects of unwholesome dwellings, the exclusion from schools of children suffering from, or known to be subject to tuberculosis, sanitation in seaport towns, over-population, and many other matters connected more or less with the health of the community were discussed at length. If only the interest stirred in the subject results in awakening the minds of the too-often slumbering authorities in towns and villages to its importance, some amount of good may be expected to accrue from these deliberations.

YET another Congress! The Archæological Institute opened a summer congress at Norwich, under the presidency of the Duke of Norwich, and spent some days in investigating the historic camps, castles, and mansions with which the county of Norfolk abounds.

PROFESSOR MAX MULLER has been delivering a course of lectures at Oxford on "The Science of Language." He said that language, if carefully studied, disclosed a simplicity more wonderful even than its supposed complexity. The science of language taught men their true position in the world. Take away language and man was lower than the dumb animals of the field and forest.

DEWSBURY AND DISTRICT TECHNICAL SCHOOL.—The first general meeting of the subscribers of these schools was held at Dewsbury, under the presidency of Alderman T. B. Fox. Mr. P. F. Lee, hon. secretary, read the annual report, which showed that the new technical school was still in course of erection, and that the classes hitherto carried on at the Mechanics' Institute would commence the winter session on the 1st of October under the management of the governors, who confidently hope to transfer them to the new building next January. The cash account showed that the money in hand was spent, but that other sums had still to come in, which, when the building was finished and fitted up, would leave an adverse balance of about £300. It was hoped that intending subscribers would aid the building fund by donations. The reports were adopted.

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Sir William Dawson has described an interesting addition to fossil botany. The specimen is that of an unique plant of the Devonian period. It is flattened and pyritised, and shows under the microscope indications of a pith surrounded by a fibrous envelope, the minute structure of which is not well preserved. The characters somewhat resemble those of the genus *Cordaites*, except that in those plants the spikes of fructification are more usually lateral than terminal. The remarkable peculiarity appears in the leaves, which, instead of having the veins parallel, have them forking at a very acute angle and slightly netted, by the spreading branches of the veins uniting with the others near them. It is considered that this specimen combines the fructification of the *Cordaitæ* with leaves akin to those of *Næggerathia*, thus connecting two groups of palæozoic plants, and it is expected that it will throw additional light on a great number of palæozoic Canadian fruits, leaves, and stems, which have been waiting for some specimen thus complete to bring them into harmony with each other.

The *Kew Bulletin* for July consists of an excellent guide to the botanical literature of the British Empire. The primary object of the compilation is to supply useful information on the literature of the systematic, economic, and geographical botany of British Possessions, Dependencies, and Protectorates. The compiler explains that Kew is often called upon to answer questions, on the shortest notice, concerning the vegetation of some remote part of the world, and the best books to consult on the subject. Such questions are not always easily answered, and they frequently entail a considerable expenditure of time. The intention is that the present guide shall supply what is wanted, and every one who may have occasion to use it will find that it is admirably adapted to its purpose.

Home Industries in Wharfedale.—An Industrial Exhibition at Burley-in-Wharfedale, promoted by Mrs. W. E. Forster, was opened on the 21st June by the Marquis of Ripon, K.G., in the presence of a large number of ladies and gentlemen in sympathy with the movement. The proposal to hold the exhibition was made with the object of stimulating ingenuity, calling out latent talent, and providing for the inhabitants of Burley pleasant occupation during the winter evenings. To the invitation, about three hundred persons—men, women, and children—responded with a heartiness which showed appreciation of the endeavour to procure their intellectual and moral advancement. In promotion of the object Mrs. Forster was able, with the assistance of a committee of workers, to get together a loan exhibition of pictures, natural history objects, and curiosities, as well as to provide money for the making of awards to those considered deserving of them; while from the South Kensington Museum an important contribution was obtained, which very much added to the attractions of the exhibition. The inauguration of the exhibition took place at the Victoria Hall. The proceedings were presided over by Mr. E. P. Arnold Forster, and Lord Ripon delivered an interesting speech in opening the exhibition.

According to *The American Monthly Microscopical Journal*, the Army Medical Museum at Washington, D.C., contains 141 microscopes and 10,416 microscopical specimens illustrating almost every field of microscopical work. Dr. Gray is in charge of this section.

Mrs. Louisa Reed Stowell has been appointed as an Assistant to the Botanist in the Department of Agriculture, Washington.

The American Society of Microscopists (Dr. Wm. J. Lewis, president) will hold its twelfth annual meeting this year at Buffalo, N.Y., beginning on Tuesday morning, August 20th, and continuing for four days.

Mr. Mellard Reade has sent us reprints of two very interesting papers. The one on "Slickensides," as will elsewhere be noticed, was read before the Liverpool Geological Society last session. That entitled "The Advantages to the Civil Engineer of a Study of Geology," was read before the Engineering Society of the same city. "My plea," writes Mr. Reade, "for the study of geology by the Civil Engineer is thus twofold—first, as improving his work as an engineer; and second, as tending to elevate his ideas as a man."

There was a crowded attendance at the London School of Medicine for Women, when the Marchioness of Dufferin and Ava presented prizes and certificates to the successful students. The cynosure of all eyes was an Indian gentleman with a Burmese wife, Mr. and Mrs. M. Hla Oung, the latter of whom was dressed in native costume. The students are all young, many of them quite girlish in appearance, and one or two of them are undeniably pretty. Lady Dufferin naturally spoke most of the needs of India, where, she said, all the self-sacrifice, presence of mind, and knowledge of women doctors would be needed, but where, on the other hand, there was a vast field for conscientious and energetic work.

Nottingham University College.—The Board of Professors at the Nottingham University College have, at the request of the College Committee, made certain recommendations as to the best means of utilising the grant of £1,400 a year fron the National Exchequer, and these recommendations have been adopted. They include the foundations of six scholarships—two of the annual value of £30, two of £20, and two of 15, with no restriction as to the sex of the scholars. In future sessions a special examination will be held for scholarships, but the present election will be based on what candidates have done at some public examination, such as the Oxford and Cambridge Locals, London Matriculation, &c. The Professors also suggest the provision of exhibitions for evening students, and they further recommend the reorganisation of the present department of mathematics, physics, and engineering, increased provision for the teaching of the natural sciences and of classics, grants to teachers in the advanced stages of certain Government classes and to teachers of technical classes, and that the balance remaining in the first year should be reserved for the equipment of the proposed technical schools, and for the purchase of apparatus.

News has reached Norway of the German exploring expedition to Spitzbergen, under Drs. Kukenthal and Watter, of Bremen. The expedition was then—in June—cruising off the south and west coasts. Many gales had been encountered. The Englishman, Mr. S. Pike, and his crew, who have wintered in the island, state that the winter was very mild.

Advices from Iceland state that there is no drift ice this summer along the island, and that the fishing on the east coast has been good.

Sand Grouse have passed the winter successfully at the Scaw in Jutland, several flocks, numbering upwards of a hundred birds, having been seen since the spring.

The herring fishery in the Baltic, which was poor last year and did not promise well this summer, has suddenly become very yielding.

Some seven or eight years ago, the late Mr. George Groom, a resident of Stavanger, on the west coast of Norway, presented a gentleman with two cock and five hen pheasants from England, which were turned out upon the common land attached to the Agricultural School at Tvedt, and which were believed to have died during the late severe winters. However, now several birds have been seen at Dagskaar, in Vikedal, demonstrating that the birds have survived and multiplied. It is hoped that they may be left in peace and augment.

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During the present summer the Copenhagen Meteorological Institute despatches weather forecasts morning and evening, instead of, as heretofore, only in the morning. The forecasts are posted at all telegraph and railway stations throughout the country.

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Both in Norway and Denmark the temperature in May and June has been 4° to 5° C. above the average. In Norway no such high temperature has been registered since the meteorological office at Christiania was opened in 1837, and in Copenhagen only once before this century, in 1801.

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A rare discovery has been made in a peat bog near Soro, in the island of Seeland, consisting of the figure of a man in sitting posture, carved from a block of oak, about two feet in height. The lines of the face are elaborately carved, as is also a prominent beard. Around the neck is carved a treble chain, there being also carvings on the breast. It is believed that it is the image of a god from Pagan times. A wooden platter was found in the same bog last year near the spot, with a treble row of wreath-like carvings along the edge, but it crumbled away on being exposed to the air. The image was found in hard untouched peat, about one foot below the surface. Only two such figures have been found in Denmark before, both being, however, far more roughly carved, and one crumbling away in the air.

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An international exhibition of horticulture will be held at Geneva from the 19th to the 24th of September next.

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The *Cape Argus* states that diamonds of the first water have been discovered in the Crocodile river, eight hours from Pretoria.

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Drawing attention to the fact that seven of the students of Queen's College, Belfast, this year were ladies, the President of the college expresses his opinion that many more ladies would resort to the class rooms were it not that the college statutes forbid their holding any scholarships and prizes. "I cannot think," he adds, "that it is right that they should suffer under this disability. There seems to be no good reason why, if ladies have the ability to gain our honours, they should be forbidden to enjoy them."

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The Rev. Father Perry, of Stonyhurst, proceeds to Cayenne, South America, in November, in order to observe the great solar eclipse which takes place just before Christmas.

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From the results of the University of St. Andrew's (Women's) examination for the present year, it appears that 536 candidates entered at 26 centres. From the beginning of the scheme in 1887, 2,210 candidates in all have entered for examination, and of these 815 have obtained the title.

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At the May meeting of the San Francisco Microscopical Society, Mr. W. E. Brainbridge exhibited and described some samples of "gem sand," which he had found in Ventura County, near the head of the Sespe river. When examined with a power of about fifty diameters it is seen to consist largely of garnets, zirconite, and what persons to whom the material was submitted in the Eastern States pronounced to be diamonds. The gems are small, appearing only the size of a rape seed when magnified fifty diameters, but the presence of such quantities of minute stones surely indicates the existence of larger members of the same family. Mr. Brainbridge remarked that he had no doubt thrown away numbers of the larger stones, thinking them loose quartz crystals, as he was only panning out the sand to find gold or large garnets. Professor Hanks, who has made a close study of the gem, stated that the small stones said to be diamonds had all the characteristics of the California diamonds. The metal platinum is also present in this sand, but whether in quantity sufficient to make it of commercial importance has not yet been ascertained. The zirconite occurs in square prisms, with pyramidal terminations, and the stones are of a light brown colour and very transparent. The sand, of which samples were shown, extends over a space of one-half to three-quarters of a mile wide by several miles in length.

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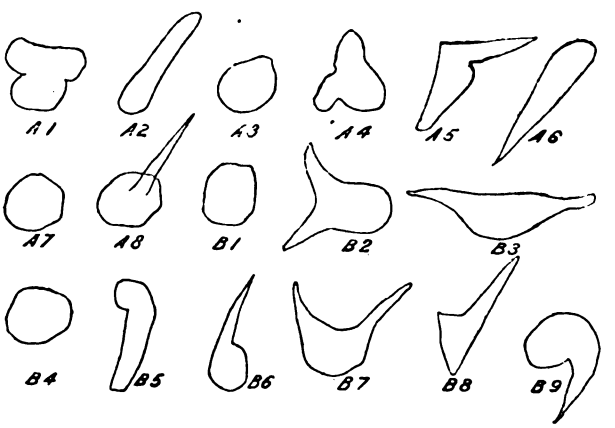
Degenerating Blood-clot.

By A. H. Taylor.

Part I.—The White Corpuscles.

During the past two or three years I have made observations on the red and white corpuscles of blood-clot, and possibly a record of a few of these may be of some interest.

(1.) Freshly drawn sheep's blood was received into a 25 % solution of $Mg\,So_4$, in the proportion of one-third blood to two-thirds of the solution. Though the mixture chemically differs very considerably from the serum in which the corpuscles normally float, yet after seven hours of this treatment, on diluting with water, several white corpuscles were found moving, perhaps rather more vigorously than usual. Figures of the movements of two are given :—



The movements were more rapid, so far as I have seen, than those made when the fluid contains a sufficiency of lime-salts, when they are often very deliberate and slow.

(2.) Again, blood received into an empty jar was placed at once in a box containing ice and left there for over 40 hours. Coagulation took place, probably before the temperature was reduced, for on opening, the greater part of the ice was unmelted. At the end of that period the majority of the white corpuscles seemed normal, their outline not being very strongly marked, and yielding to the red as those pressed against them. Unfortunately heat was applied almost immediately, and the change from cold to heat being too sudden, the slide was spoiled.

(3.) In another case a small quantity of bullock's blood was simply poured into a jar in which a little meat peptone was mixed with a little water and a small quantity of sugar; the peptone and sugar were added in the hope that by supplying nourishment the corpuscles might be kept longer in a healthy condition. Twenty-four hours afterwards one of the white was noticed to continue for about half an hour to make movements more vigorous than any I have observed in freshly-drawn human blood.

And later, forty hours after the death of the bullock, another was watched moving vigorously and continuously during two hours, and, when observed at intervals for three hours longer it was still always

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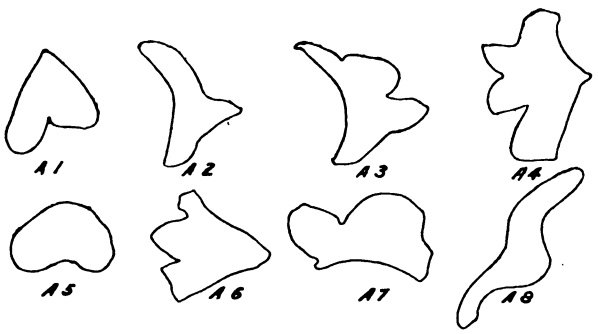
found (if resting) to move in a minute or two. Had the meat peptone any influence?



(4.) In another case a clot of sheep's blood was floated in a solution—approximately—of salts of plasma :—

Na Cl (Chloride of Sodium)	5·5 grammes to 1000 grammes of undistilled water.	
$Na_2 HPO_4$ (Phosphate of Sodium)	0·27	,, ,,
$Na_8 HCO_3$ (Bicarbonate of Soda)	1·28	,, ,,
$Na_2 SO_4$ (Sulphate of Soda)	0·25	,, ,,
K Cl (Chloride of Potassium)	0·35	,, ,,
$K_2 SO_4$ (Sulphate of Potassium)	0·28	,, ,,
$Ca H_4 P_2 O_8$ (Phosphate of Lime)	0·29	,, ,,
$Mg_2 (NH_4)_2 P_2 O_8$ (Phosphate of Magnesia and Ammonia)	0·21	,, ,,

A little sugar and a little freshly peptonized milk were also added. This was not examined until 64 hours after death ; not many white were found on the slide, and the movements of the corpuscle selected for notice were extremely slow, and only perceptible after considerable intervals, when, on comparing it with the drawing made about half-an-hour before, change was observed. It had inclosed a bacterium, and looked very much as if it were going to divide into several corpuscles, though division did not take place while it was under observation.

(5.) In another case, sheep's blood was passed into a similar solution of plasma salts, to which a little ferment of sheep's blood had been added. The clot contracted more than usual, and the serum squeezed out clotted. On examining between two and three hours later, the white corpuscles did not seem affected by the excess of ferment, one or two were moving ; and 40 hours later slow movements were still seen. Then the clot blackened, and was thrown away.

In none of the above experiments was the temperature of the room noted, but they were all, except the first, conducted during the late spring and the summer months.

(6.) In another experiment, the endeavour was made to place the clot in more natural conditions by securing a uniform motion of the liquid in which it was placed. In several of the experiments mentioned above this had been attempted by arranging that the fluid should slowly fall, drop by drop, into and out of a basin containing about half a litre of the liquid in which the clot was suspended. This arrangement secured only very slight motion however, and was also apt to get out of working order.

In this case the blood, which was bullock's, was received into a jar containing 0·5 p.c. Na. Cl. solution, in the proportion of three-fourths solution to one quarter blood, and within two hours the clot formed was put in a small piece of muslin, and suspended so as to be only partly immersed in a jar containing 5000 c.c.m. of a mixture intended to represent serum, the fluid being kept continually in gentle motion by a kind of wheel made of four glass plates. The blood was diluted in order to prevent the clot being very stiff and firm. The mixture was as follows :—

Na Cl	5·39 grammes to 1000 parts of water.	
$Na_2 SO_4$	0·24	,, ,, ,,
$Na_2 HPO_4$	0·05	,, ,, ,,
$K_2 SO_4$	0·414	,, ,, ,,
Na H CO_3	1·16	,, ,, ,,
$Ca H_4 P_2 O_8$	0·24	,, ,, ,,
$Mg_2 (NH_4)_2 P_2 O_8$	0·022	,, ,, ,,

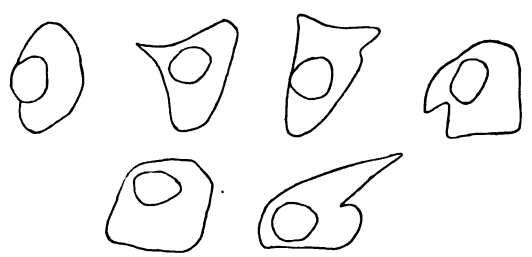
The water was ordinary London water, undistilled, and unboiled, and probably contained enough, or more than enough lime, to make up for the small amount of that salt used.

To these salts were added Glucose 1·2 grammes to 1000 parts water.
Benzoic acid 0·2 ,, ,, ,,

Benzoic acid has a preventive action on the development of bacteria ; and being a normal constituent of the food of cows, &c., and being excreted as hippuric acid, it probably has a less disturbing influence on the corpuscles than some other antiseptics ; and (judging from the comparatively long time during which the clot remained undiscoloured), it promotes oxidation, as uric acid has been proved to do. There was constantly some deposit in this mixture. It was renewed every 24 hours for the first ten days, but the quantity supplied was reduced to one half during the second week. The jar was covered loosely by a black cloth in order to modify to some extent the effect of light.

The clot remained of a bright red colour for five days, when it turned a brown red ; possibly from having been hung too low in the fluid, or perhaps owing to the fresh mixture having been still rather warm when put into the jar. No heat was applied to the jar : the temperature of the room in which it stood was about 50°F. during the day.

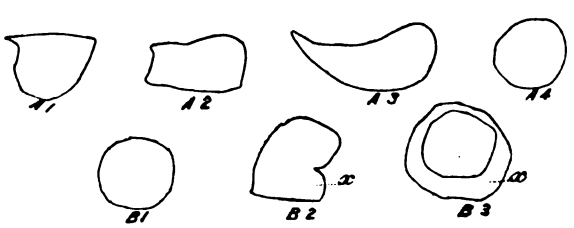
Sixty-six hours after death a white corpuscle was found moving.



The white corpuscles found on the slide were fewer than on the preceding day, and most of them were very coarsely granular, and distinctly outlined.

On the following day, 89 hours after the death of the bullock, still fewer white were found ; a large one was noted, which had several nuclei—its form changed slightly from round to pointed, then became rather square, and so on ; but these changes took place very slowly. The nuclei also changed position, slightly moving towards the circumference, and back towards the centre ; but this motion was so slow, as to be with difficulty perceptible, the changes of position being best seen on comparing drawings made at intervals of a few minutes.

On the 8th day after the killing of the bullock, very few white corpuscles were to be found on the slide ; however, three (granular, but not very coarsely granular) were got on the field. One of them "A" was in a very few minutes seen to be moving leisurely, yet not very slowly.



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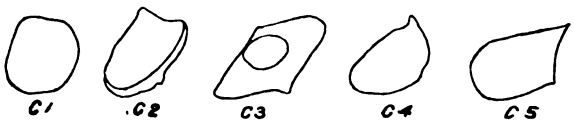
These movements took place, as did also those spoken of in No. 5, at the temperature of the room, *i.e.* 50°F. in this case. On applying, heat "A" did not move after assuming the round form. But, a more granular corpuscle, "B," changed form slightly, and threw out a perfectly clear substance, *x*. And a few moments later the third corpuscle "C" (larger and more coarsely granular), was also seen for about three minutes to make slow movements, at one time showing a nucleus, which was again obscured.



The points worthy of note seem to be:—(1) The gradual lessening of the number of white corpuscles as the days passed, though the number found on the slide seems also to depend partly on the part of the clot from which the bit of fibrin is taken; (2) their becoming more coarsely granular; and (3) movements, when they take place, becoming slower. Concurrently degeneration products appear, bacteria increase in number, and changes take place in the red copuscles; all perhaps evidences of decreased oxidation and vitality. But the vitality of the white corpuscles and their power of resistance to some re-agents is surprising.

(To be continued.)

Museum Notes.

THE annual meeting of the Manchester Arts Museum at Ancoats was held on the 5th July, at the Manchester Town Hall. Mr. D. Ainsworth Little read the annual report, in which the committee recorded that during the past twelve months the work at Ancoats Hall had been steadily carried on, and that the munificent gift of £500 from the residuary legatees of the late Sir Joseph Whitworth, with donations of £200 each from Mr. J. P. Thomasson and Mr. T. C. Horsfall, had enabled them to pay the debts, which in the last two annual reports were mentioned as causes of anxiety. The turnstiles at the Museum recorded a decrease in the number of visitors, but this was more than accounted for by the fact that fewer children had been admitted during the past twelve months than previously. The children had been given to understand that on certain evenings, particularly Mondays and Thursdays, music and readings were specially provided for them. The weekly attendance had averaged over 1,000, but a very large proportion of the visitors came chiefly for the musical and other entertainments. The weekly lectures had been continued, and a reading party met during the winter months. The drawing and wood-carving classes had again met under the guidance of Mr. Ward Heys and Mr. T. W. Hill, and Miss Solomon had also conducted a clay-modelling class during the winter months. The wider interest taken in the Museum was shown by many visits of people interested in art from London, Birmingham, and other places; as the result of a visit by Professor Petersen, of Dundee, the committee of the Dundee Art Museum had decided to adopt the same methods in several of their rooms. Loans of pictures had been made to a number of schools and societies, and several gifts of works had been received.

LIVERPOOL MUSEUM.—This institution has just become possessed of a truly strange fish, in the shape of a Lepidosiren, or mud-fish. It belongs to a rare genus, which exhibits many rudiments of an early form of fish. It is a native of the Gambia River, and it has learned how to bury itself in the mud when the river dries up and the hot seasons are scorching all the land. It will lie for months in the hole it has made for itself in the mud, and when it comes out, with the advent of the rainy season, it is simply ravenous from the effects of its long hibernation. It can breathe air or water, but it has never been seen to leave the river except when it goes to sleep in the mud. These rare eel-like fishes are sometimes brought to England in a lump of earth, sleeping their long dry-weather sleep. When placed in warm water they wake up and come out into the strange English waters. One lived for some years in the tank at the Crystal Palace, but it died because the fire went out one night and the water grew cold. In the Liverpool Museum there is no artificial heat for the aquarium, so the probabilities are that the mud-fish will die soon, but it is living now, and swims about in a curious eel-like way, showing no desire, however, to devour the fishes which have been placed beside it in its muddy tank. The tiny English fishes investigate their strange African companion, with no idea, apparently, of its nature or of their own ultimate doom if it lives and thrives. It is many years since such a treasure was seen alive in our museum, and this will probably attract a great deal of attention; but the limited means possessed by the curator, Mr. Moore, will doubtless be unable to preserve alive this strange specimen of a little-known fish.

MR. F. P. MARRAT, Liverpool Free Public Museum, sends us the following suggestion:—"In the cases exposed in the various museums in England may be seen certain peculiar vases, &c., in wedgwood ware. These are intended to represent various natural stones, such as agates, porphyries, jaspers, and many other ornamental minerals. The porphyries are mostly green, red, brown, or olive, with very small angular crystals, which are much paler than the matrix in which they are set. Many of the agate vases are also very peculiar in colour, and specimens closely resembling them would be very difficult to procure. The jaspers seem to have been chosen rather for their rarity and beauty than for the artistic skill required in imitating them. If specimens could be obtained and placed in the cases with the vases, showing even near approaches to the manufactured article, it would greatly assist the student in his examination of these objects. I have not only seen, but absolutely possess, a few small examples of the minerals, similar to those from which some of these vases have been copied."

AN important acquisition has been secured by the Museum at Nurnberg, which has just bought a collection of antiquities formerly in the possession of Count Josef Maria von Sulkowski, the well-known antiquarian. The collection includes a large store of old weapons and armoury, and many other historical relics. It is said that no less a price than £10,000 has been paid for this collection.

EVERY museum, where excellence in the Natural History Department is at all the aim of the authorities, should establish and keep up an aquarium, which, even if of only unpretentious size, will usually be found to be a strong source of attraction. By way of commencement a couple of tanks, or small glass jars, such are so commonly used for domestic or drawing-room aquaria, will be found quite enough to excite an interest on the part of the public, and, where the space and means at disposal permit, increased facilities for exhibiting fishes and other aquatic forms of life in their native element will usually repay the trouble entailed in their establishment. Active life is always more popular and instructive than still life, and the beginning of many a valuable career in biology may be traced to the interest stirred by watching and studying the habits of some of the denizens of our ponds and ditches in the aquarium-room of a local museum.

ACCORDING to the French *Journal Officiel*, of 3rd July, the President of the Council has sanctioned the creation of a Commercial Museum by the Chamber of Commerce of Oran, in Algeria.

THE report of the Curator of the Grosvenor Museum, Chester (Mr. Newstead), is very satisfactory, and it is to be hoped that the additional facilities soon to be placed at his disposal, on the completion of the projected addition to the building, will serve to increase still further the excellence of the local collection which the energy of the Chester Natural Science Society has already secured. Mr. Newstead announces that the additions during the past year exceed those of the previous year by more than 600 specimens, and include some rare species. The most important addition to the *Coleoptera* is a collection of 175 species (mostly new to the museum) presented by Dr. J. W. Ellis, of Liverpool. A large collection of *Lepidoptera* has been added through the generosity of Mrs. Leather, of Delamere. Two groups illustrating the life-histories of birds—heron and sparrow-hawk—have been prepared and mounted. The important work of numbering and cataloguing the collections has progressed.

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THE Chester Collection is confined to local species, a wise proviso in the case of a local museum. In order to stimulate research, the committee of the Chester Society offer a prize, from the Kingsley Memorial Fund, value ten pounds, for the most valuable collection of objects in any one branch of natural history made in the society's district. The successful collection may be retained at the option of the committee for the Society's Museum, and an incentive thus given to render the museum a complete and worthy record of the local natural history.

Our Portrait Gallery.

XV.—PROFESSOR WILLIAM HENRY FLOWER, C.B., LL.D., F.R.S., F.R.C.S. PRES. Z.S., &c.

WILLIAM HENRY FLOWER, now the distinguished naturalist, Director of the Natural History Department of the British Museum, South Kensington, and President-elect of the British Association, was born at Stratford-on-Avon on November 30th, 1831, and is the second son of the late Mr. Edward Fordham Flower, J.P., of The Hill, Stratford-on-Avon, and Celina, daughter of the late John Greaves, of Radford Semele, Warwickshire. He received his education first in private schools and afterwards in University College, London, and early exhibited a taste for natural history pursuits, which led him to select medicine as a profession. He matriculated at the London University in 1849 with honours in zoology, and entered as a pupil at the Middlesex Hospital, where his career was marked by many brilliant successes. He passed his first M.B. in 1851 at the London University, in the first division, and qualified as a member of the Royal College of Surgeons in 1854. Afterwards, with the object of improving his knowledge of surgery, he entered the medical department of the army, and acted as assistant surgeon to the 63rd Regiment in the expedition to the Crimea. The great hardships he there encountered, together with exposure to the severe climate affected his health, and he was consequently invalided. Soon after his return to England he received from the Queen the war medal, with clasps for Alma, Inkerman, Balaclava, and Sebastopol.

He shortly afterwards resigned his position in the army, and became Demonstrator of Anatomy in the Middlesex Hospital. He was admitted a Fellow of the Royal College of Surgeons in 1857, and in the following year was elected assistant surgeon to the Middlesex Hospital, where he also became curator of the museum and lecturer on comparative anatomy. Whilst thus occupied he published a work entitled *Diagrams of the Nerves of the Human Body*, and wrote on *Injuries of the Upper Extremity* for Holmes's *System of Surgery*, and contributed a paper on *Dislocations of the Shoulder Joint* to the Pathological Society. He also made several other contributions on surgical subjects to the medical journals.

In 1858 he married a daughter of the well known astronomer, hydrographer and antiquary, Admiral W. H. Smyth, F.R.S.

In 1861 he was appointed to the office of Conservator of the Museum of the Royal College of Surgeons of England—the Hunterian Museum—and his labours whilst holding this post were of vast importance in increasing the value of this great museum for the purpose of medical education. He most ably reorganised it, and added greatly to its contents.

When, in 1869, owing to the retirement of Professor Huxley, the Hunterian Professorship of Comparative Anatomy and Physiology in the Royal College of Surgeons became vacant, Mr. FLOWER was appointed to it, and most ably sustained and added to the renown of this professorship, his lectures, including those on the "Osteology of the Mammalia" and the "Comparative Anatomy of Man," being of the utmost value as contributions to anatomical and biological science.

In 1864 he was elected Fellow of the Royal Society, of which he has been several times a member of the council, and vice-president. In 1879, when the presidency of the Zoological Society became vacant on the death of the Marquis of Tweeddale, Professor FLOWER, who had already been a member of the council and vice-president, was elected to the post, which he has filled with conspicuous ability and advantage to the society, and so as greatly to aid the progress of zoological science. In 1879 he was vice-president of the Anthropological Institute of Great Britain and Ireland, and became president in 1883. His presidential address, on January 22nd, 1884, was on "Aims and Prospects of the Study of Anthropology," and in it he clearly indicated the importance of this special branch of study, and pointed out what an immense field of inquiry it embraced, and then mentioned in detail the recent advances that had been made. The second presidential address in the following year was mainly devoted to an exposition of his views on the classification of the human species. Professor FLOWER was also president of the anatomical section of the International Medical Congress, at the meeting in London, in August, 1881, when he delivered an inaugural address on "The History and Progress of the Museum of the Royal College of Surgeons," and he has been also a vice-president of the Linnæan Society. At the Royal Institution he has delivered many lectures and addresses on biological and anthropological topics.

In 1882 he received one of the gold medals of the Royal Society, awarded to him by the council in recognition of his services "in extending our knowledge of comparative anatomy and zoology in general, and of the mammalia in particular," and also, as stated by the president when presenting the medal, because "it is very largely due to his incessant and well-directed labours that the museum of the Royal College of Surgeons at present contains the most complete, best ordered, and most accessible collection of mammalian and vertebrate structures extant."

A notable speech by Professor FLOWER was made at the meeting of the Church Congress, at Reading, in October, 1883, when, at the request of the council, he opened a dis-

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PROFESSOR WILLIAM HENRY FLOWER, C.B., LL.D., F.R.S., F.R.C.S., PRES. Z.S., &C.

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cussion on "Recent Advances in Natural Science in their Relation to the Christian Faith," and in so doing he gave a clear and able statement of the position of the doctrine of evolution, with the object of mitigating the prejudice of many of the strong opponents to the doctrine amongst the clergy.

In the year 1884, Sir Richard Owen having resigned the office of the Director of the New Natural History Museum at South Kensington, the trustees of the British Museum selected Professor FLOWER for this important office, and he then resigned his post at the Royal College of Surgeons, after twenty-two years' service. On his retirement the Council of the College passed a most flattering resolution recording their high appreciation of the services he had rendered to the institution. On the death of Sir P. de G. Egerton he was appointed trustee to Sir John Soane's Museum, and in 1885 a trustee of the Hunterian Museum. At the ter-centenary of the University of Edinburgh, his services to science were recognised by the conferring on him of the honorary degree of LL.D.; and his important scientific work received further recognition at the time of Her Majesty's Jubilee, when the Companionship of the Bath was conferred upon him. He has also received the honorary degree of LL.D. from the University of Dublin, and has several times been an examiner for the University of Cambridge.

Professor FLOWER has contributed largely to the literature of anatomy, zoology, and kindred sciences in the journals of different societies and has written important separate volumes, amongst which may be mentioned that valuable work, the "Osteology of the Mammalia;" also the catalogues of the pathological preparations, and those of osteology in the Museum of the Royal College of Surgeons, and other useful works. As illustrating his great ability to write on scientific subjects in a popular manner we may mention a most interesting work, one of the *Nature* series, entitled "Fashion in Deformity," in which he shows the distortions of the body and other evils brought about by too great a deference to the laws of fashion.

In connection with the British Association, over which he will this year preside, he has held the office of vice-president of Section D (Biology), presiding over the department of Anatomy and Physiology, at Norwich. In 1878 he was president of the whole section at the Dublin meeting, and in 1881 president of the department of Anthropology at York. Further, in 1885, he was a vice-president at the Aberdeen meeting.

The positions he has held, and distinctions he has received testify to the earnestness and value of Professor FLOWER'S scientific work, and the estimation in which he is held in the world of science.

And not only has he laboured earnestly himself, but he is also known as ever ready to give kindly help to others; and many a student must have pleasant recollections of his willing and valuable aid.

Professor FLOWER has, in fact, done such really good work in many directions that his name must always stand as one of the most popular, talented and useful of the eminent scientific men of his day. A. N. T.

Local Museums.

VII.—Leicester.

THE town of Leicester possesses one of the best museums in the provinces, the arrangement of the specimens being in some points quite unique. The Museum is pleasantly situated in grounds which also contain the School of Art and the Corporation Art Gallery.

Taking the various departments of the Museum in alphabetical order, the Archæological Room proper, on the ground floor, is filled with a mass of material which forcibly illustrates the antiquity and importance of the ancient borough.

Should the mind of the visitor happen to be of a "prehistoric" cast, his eyes are certain to be delighted by the sight of the case which contains all the local prehistoric remains possessed by the Museum. This case may be said to be the outcome of a paper recently read by the curator, Mr. Montagu Browne, before a section of the Leicester Literary and Philosophical Society, and briefly reviewed in a late issue. Nearly all the specimens therein described will be found displayed, some of the most interesting being the rudely-fashioned tools of deer-antlers from excavations at Barrow-on-Soar, discovered by Mr. Browne, stone and bronze articles, as well as some beautiful examples of early British pottery.

From this point to the Romano-British period is an easy transition, and, bearing in mind the important position which Leicester then occupied, we are naturally prepared to find the record of that portion of the history of the town almost complete. Nor are we disappointed, as the plethoric condition of six or seven large wall-cases amply testifies. Upchurch, Samian, Salopian, and Castor ware are represented by very fine examples, while the glass, bone, and metal objects contain amongst their number some almost unique specimens. In a case of Roman remains from Barrow-on-Soar, presented by Messrs. J. Ellis and Sons, may be noticed a magnificent two-handled glass cinerary urn, absolutely perfect, and beautifully executed. Amongst other things which will catch the eye in passing are a fine and almost perfect vase of Castor ware, two huge amphoræ from Barrow-on-Soar, a hollow flue-tile inscribed PRIMVS FECIT, from Highcross Street, some pieces of glass embossed with figures of gladiators, &c., a piece of a Samian bowl -once a love token, as evidenced by the rude inscription VERECVNDA LYDIA LVCIVS GLADIATOR—a fine collection of potter's marks, fibulæ, rings, and a host of other things too numerous to mention. In the annexe, close to the Archæological Room, are displayed some architectural fragments and tesselated pavements from various excavations in the town.

Of the Anglo-Saxon and later periods no lack of specimens will be found in the wall-cases in the Archæological Room. Of mediæval relics, we may notice a specimen of the "Branks," or "Gossip's Bridle," and a number of examples of earthenware vessels (Bellarmines and other forms) from excavations in the town and county. The centre of the room is occupied by cases containing an assortment of ethnological objects; these are only a portion, however, of the entire collection possessed by the Museum, the remainder having to be stored away through want of space for exhibition. Indeed, the whole of this department shows evident signs of overcrowding, and it is hoped that additional rooms will be provided in the near future. The Egyptian

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antiquities in the annexe comprise some mummies, two (male and female) from the site of the ancient Panopolis, presented by Mr. J. M. Cook, being remarkable for their fine state of preservation.

The two rooms adjoining the Archæological Department contain the collections of geology and palæontology. The most striking feature in the palæontological collection is, undoubtedly, the large wall-case containing the Barrow *Plesiosaurus* and *Ichthyosauri*. These are justly famed for their perfect preservation, and form the chief glories of the local collection. The Museum also possesses a typical collection of fossils, at present in process of re-arrangement, and it is intended to make local collections of Liassic, Rhætic, and other fossils a special feature in the new arrangement. In wall-cases at the lower end of the room are placed a choice series of extinct, local, vertebrate remains, including amongst their number fine teeth of *Elephas* and *Rhinoceros*, various bones, &c., of *Bison*, *Bos primigenius* and *B. longifrons*, marsh-hog, red deer, reindeer, &c. Several of these are new additions to the county lists, and their discovery is due to the exertions of the curator. Amongst the collection of minerals may be noticed a fine series of ores of silver from Chili, the gift of R. Jacques, Esq.

Retracing our steps, and ascending the stairs in the entrance-hall, we enter the Zoological Room, which is, *par excellence*, the unique feature of the Museum. The plan of the room at Leicester is devised with a view to provide for the adequate exhibition of both general and local forms. The walls are lined by a series of polished oak cases glazed with plate glass, which serve to accommodate the general collection of vertebrates. These are arranged pictorially, the classification adopted being in every case that of the most modern authorities. Commencing our survey of these cases with the lowest forms, we turn to the right on entering the room, which brings us face to face with three bays containing fresh and salt-water fishes. The arrangement of these is both striking and novel, the idea being to transform the cases into imaginary sea and river-bottoms, in which the fishes appear as in their natural elements. This well-conceived idea has been very finely executed, both as regards the artistic accessories and the positions, &c , of the specimens themselves. Of these latter we may notice a fine sturgeon, taken in the river Trent at Newark many years ago, some curious globe fishes, a fine shark, and a number of other interesting forms ; the case of fresh-water fish is also well filled with specimens. In both instances the glass at the top of the bays is painted—in the one instance with floating leaves of the water-lily, in the other with trailing fronds of fucus, and this, together with the skilful background (in the case of the marine fishes, of seaweed-covered rocks receding into the distance) gives an air of reality to the groups, which is a charming novelty. In the gallery above are two cases of amphibia and reptilia filled with various forms, and serving to connect, as in a diagram, the fishes and birds.

The general collection of birds occupies one side and parts of the two ends of the room. Each of the bays of this long range of cases is a picture in itself, there being no approach to sameness in the treatment of the rockwork and accessories in the various groups. The first four bays contain the *Passeres*, *Macrochires*, and *Picariæ*, a goodly number of specimens being on view. Amongst the most striking forms may be noticed some lovely birds of Paradise, including the rare *P. raggiana*, the curious umbrella-bird of South America, some gorgeous trogons, pittas, and kingfishers, a charming group of humming-birds, including some rare species, and specimens of horn-bills and toucans. A very ingenious arrangement obviates the necessity of placing descriptive labels in the cases—a proceeding which would prove inimical to their artistic appearance. It consists essentially in the preparation of coloured drawings of the contents of the various cases, each figure on the chart bearing a distinctive number. Printed lists are also prepared giving the necessary information, such as name, range, &c., of each specimen. These lists are numbered to correspond with the coloured charts, and both charts and lists are fixed in prominent positions outside the case to which they refer. Several of these are in position at the present time, and it is intended to complete the series shortly.

There are many individual specimens in this collection worthy of more than a passing notice, such, for instance, as a fine owl parrot from New Zealand (a bird whose numbers are rapidly diminishing, owing to the onslaughts made upon it in various ways), two peregrine falcons from Caithness, beautifully mounted—one being in the act of swooping down upon its prey—and a fine specimen of the white stork (*Ciconia alba*) shot close to the town of Leicester some years ago. In the case of *Anseres* adjoining is a black-necked swan from South America, seeming to glide with outstretched neck upon the surface of the water, which forms a miniature bay at that point of those artistic bits.

Amongst so much that is interesting on this side of the room, attention may be drawn to the bays containing the gulls, terns, and allied forms, with their rocky surroundings delicately tinted in the way so familiar to lovers of coast scenery. The groups of gulls with their young are beautifully managed, another interesting feature being an adult penguin with a young bird in close proximity, showing the striking difference in outer aspect which exists between the two stages, the gaily-coloured adult contrasting strangely with the sombre brown of the immature bird.

The collection of mammals occupies a corresponding series of cases on the opposite side of the room, and is treated in the same pictorial manner as the birds. The first group which meets us in our progress from the lower forms upwards is specially notable from its somewhat unique character, showing, as it does, a series of the duck-billed platypus, together with an ideal section of the burrow and nest of the animal. The forepart of the case is occupied by a sheet of water overhung by branches, from which trail masses of algæ left by the receding water; at the back rises a steep bank, in the substance of which is shown the winding burrow and terminal nest in ideal section. The specimens are eight in number, three being upon the bank by the water side, one just clambering on to the bank, another swimming towards the burrow, out of which another is diving into the water. In the burrow and nest are the remaining specimens, while upon the bank above is a specimen of the echidna (*E. hystrix*). Further up the room will be found a skilfully-executed group of two Polar bears upon an iceberg.

The curator has inaugurated an entirely new system in the setting up of mammals. Light paper models replace the antiquated though commonly-used "stuffing," and his new method has the advantage of permitting the reproduction, with the greatest facility, of the various groups of muscles which give such character to the living animals. As an illustration of the capabilities of this new process we have only to turn to a large group, which represents two tigers fighting over the body of a dead elephant lying prone in an isolated patch of jungle. The attitudes of both animals are full of life and vigour.

Amongst other specimens in the series of cases which are likely to attract attention are :—One bay of edentates containing specimens of the giant armadillo, pangolin (*Manis tricuspis*), peba armadillo (*Dasypus peba*) Hoffman's sloth (*Cholapus hoffmanni*), and others ; four bays of ungulates, in which we see an elk, water musk-deer (*Hyomoschus*), a stag from Bradgate Park, near Leicester, an oryx antelope from Africa, tapir, rhinoceros, &c. ; and another range of bays containing *Carnivora*.

In the adjoining case of *Quadrumana* is a specimen of the curious aye-aye (*Chiromys madagascariensis*) from Madagascar, and some monkeys and lemurs ; man is represented by a bay filled with skulls, many of them from excavations in the vicinity, together with types of some other nations ; there are also some prehistoric examples, such as the Neanderthal and Engis skulls.

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The local groups form an important part in the collection. In the treatment of the local vertebrate fauna the species are kept, as far as possible, to themselves, in separate cases, which, when practicable, contain the male, female, and young, and, in the case of the *Aves*, nest and eggs, the whole surrounded by specially-modelled foliage and accessories. The success of this arrangement—though the scheme is as yet only partially carried out as regards the number of species exhibited—has proved satisfactory in kindling an interest in objects of local interest.

In this portion of the Zoological Room perhaps the most striking group is a case of herons and young, from Stapleford Park. Two nests are shown, with the young birds in two stages, those in the larger nest represented in the act of being fed with an eel by the parent. Close by are three small groups of robins, whitethroats, and blue titmice respectively. The group of whitethroats is no less beautiful, though in this case the nest and young are placed in the midst of a finely-modelled bramble bush, which bears witness to a close study of the minute peculiarities of the original in the graceful disposition of the trailing shoots, the imperfections of many of the leaves due to the depredations of various *larvæ*, and in many other points. Both parent birds are present, one of them engaged in feeding the young.

The blue titmice have made their nest in the stump of an apple tree, from which spring fresh twigs in full leaf. The varied colouration of the stump is well rendered, as are also the attitudes and arrangement of the numerous family it shelters. In the slants of the case containing these groups are exhibited a series of local nests and eggs, arranged in separate glass-topped boxes. Some of them are specially interesting, and all derive additional value from the association of the nests with the eggs belonging to them, a feature which is not often observable in collections of this kind.

Coming now to the consideration of science in its more strictly educational aspect, we find that this important branch of museum-work has not been overlooked. In some upright cases in the centre of the room are displayed a series of osteological preparations, which will prove of much service to the student of comparative anatomy. The curator had for some time been alive to the advantages of an arrangement which should permit an easy comparison between the variously modified bones in different vertebrates. The system in vogue at Leicester can certainly claim to have wonderfully simplified matters in this direction. It consists essentially in colouring the actual bones with strongly contrasted tints, sharply defining their various limits. As all the bones throughout the series are coloured on one fundamental plan, the comparison of one with another—from fishes to man—becomes both easy and pleasant.

Amongst the skeletons, &c., displayed in the case are a human skeleton, two fine skeletons of the gorilla, skulls of man, tiger, bear, cat, dog, and other preparations too numerous to mention. An index Museum of birds is in course of construction.

The weakest part of the Museum is the invertebrates, though it is not fair to expect much in this direction at present, seeing that more than half the collections have to be stowed away through want of space for their exhibition. It is, however, only a question of time for the invertebrate departments to take rank with the vertebrate collections in beauty and completeness of arrangement. The sanction of the Town Council for the building of a room is urgently needed. Leicester is undoubtedly behind towns of less importance in this particular, and, as it is impossible to make the best use of vertebrate collections without first studying a representative series of the invertebrates, it is to be hoped that the necessary additional room may ere long be provided.

In every department of the Museum much credit is due to the present curator, Mr. Montagu Browne, for the excellence and originality of the arrangements of the various natural history collections displayed within the Institution under his care.

More about the Gorilla "Jennie."

OUR readers have already made the acquaintance of "Jennie," the young female gorilla which unfortunately died before it could be brought to England (see *Research*, vol. I, pp. 143 and 188). We have been favoured by Mr. T. J. Moore, Cor. Mem. Z.S.L., with the perusal of a letter from Mr. J. J. Jones, trader at Ngove, West Coast of Africa, the owner of "Jennie," from which we have been permitted to extract the following interesting details. We give the narrative, as far as possible, in the writer's own words. Certainly we would wish to add nothing to the touching and graphic account with which the letter closes :—

"You ask me for an account of the life and pedigree of dear old Jennie. Well, about the middle of October, 1887, a small canoe arrived, with two natives and Jennie in it. She was more dead than alive, and I did not think she would live through the night. However, after some bargaining, the natives took what I offered them, and left. I then put Jennie into a small rug, and afterwards placed her in my gorilla-house, with plenty of straw and a rug for herself. She lay quite contented. In a week's time she took to me so well that she used to follow me about like a dog, would come and jump on my back, and put her arms round my neck. While I was engaged on some work she would go into the bush for 'chop' (food), and if she found I had gone would make a fearful noise until she found me. One night a swarm of 'drivers' (ants) attacked her, and I took her into the house, and let her sleep near me. She was very playful, and would wrestle and box with me like a small boy, and follow me about everywhere. I taught her to sit upon a chair at table at chop-time, gave her a plate, cut up her meat and potatoes, and gave her a glass of water or beer. She would eat and drink like any christian. When the bell rang for chop-time she would pull her chair up to the table. She could drink out of a glass or bottle without spilling a drop or breaking the glass, being always careful to replace it upon the table. I also taught her to turn the niggers out of the shop. She knew my voice and footstep, and often when I left her would walk over to the factory to find me. One evening I gave her some wine, which she soon finished and then collared mine and finished that, and soon was quite drunk. When she got sober she never would take any more of that. If, when I was sitting with Jennie in the piazza and it was rather cold, she would run to my bedroom and bring out my rug, hand it to me, and wrap herself in it. She was very fond of young children, and if any child came to the factory she would touch its face and hands as softly as a grown person would, and do her utmost to talk. She was very fond of jams and pickles, and, in fact, was always ready for anything good. When taking a walk with Mr. N—— Jennie would walk between us, with one hand in Mr. N——'s and one in mine. . . . . One day she was playing in the morning with Mr. D——. In the afternoon I returned, and noticed that she was not able to walk as usual; something seemed wrong with her legs. I took her in my arms and did what I could for her. She seemed in great pain in her stomach, and I gave her some chlorodyne, which seemed to relieve her. Next morning I found she could not stand, so I nursed her that day. She would cry if I put her down for a minute, just as a very small weak child would do, and never seemed content unless her face was near mine. About 4 o'clock she had some milk; she then got a big fever, and, after walking about with her for hours in my arms, I took her to bed, but she was so bad I did not sleep. She took my face between her two little hands and drew me towards her until her face touched mine, crying all the time. After a few minutes she heaved a sigh and pressed my face with her hands, and then I found she was dead. Poor little Jennie!

The writer of the above narrative adds that he hopes to obtain another gorilla, which he intends to train, and make it the "greatest wonder of the world." The skin of poor Jennie will probably be sent to a museum in England.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between July 16th and August 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S., F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	....Highest (July 29th)	30·16	Inches.
,, ,,	....Lowest (July 25th)	29·46	,,
,, ,,	....Mean	29·819	,,
,, ,,	.... ,, for 22 years July.....	29·923	,,
,, ,,	.... ,, ,, August	29·925	,,

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Temperature	Highest (July 30th)	78·0	Deg. F.
,,	Lowest (July 18th)	49·3	,,
,,	Mean	59·1	,,
,,	,, for 22 years July	60·8	,,
,,	,, ,, August	60·4	,,
,,	,, of Evaporation	55·0	,,
,,	,, ,, for 22 years July	56·6	,,
,,	,, ,, ,, ,, August	56·4	,,
(*b*) Rain all	Amount	3·163	Inches.
,, ,,	,, Mean for 22 years July	3·044	,,
,, ,,	,, ,, August	2·706	,,
,,	Number of Days on which Rain fell	20	
,,	Greatest fall in 24 Hours (July 24th)	0·520	Inches.
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·7	
,,	,, ,, for 22 years July	6·5	
,,	,, ,, ,, August	6·4	
(*c*) Wind	Velocity, Greatest (July 21st)	52	Miles.
,,	,, Least (July 28th)	0	,,
,,	,, Mean Hourly	15·6	,,
,,	Greatest Pressure on Square Foot (July 21, 8-30 p.m.)	27·0	Pounds.
,,	Direction at time of Greatest Pressure	WNW	

Number of Hours that the Wind blew from each of Eight Points of the Compass.

NE	E	SE	S	SW	W	NW	N	Calm Hours.
0	10	81	60	113	304	138	37	1

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

◆◆◆◆◆◆

Bolton.

From the 15th to the 21st July the barometer oscillated three times, with mean below the average; passing showers on five days, with fair amount of sunshine. The weekly averages were:—Barometer 29·781 in.; mean temperature, corrected for daily range, &c., 53·15°; humidity 75%; total sunshine 25 hours; rainfall 1·237 in.; gentle Westerly breezes. From the 22nd to the 27th the barometer continued low and unsteady, afterwards rising to 30·136 on the 30th, but declining again on the 31st, making five oscillations in the ten days. On the 24th 0·948 in. rain fell during 14 hours. Temperature was very irregular, ranging from 50·1° to 66°. Averages:—Barometer 29·871 in.; mean temperature 56·12°; humidity 78%; total sunshine 47 hours 55 minutes; rainfall 1·226 in.; prevailing wind West.

The mean pressure for the month of July, 29·919, was slightly above the average, and the number of oscillations 14. The mean temperature, 56·37°, was 2·6° above the corresponding month of last year, and just the average of the past four years. The temperature of the soil and water at one foot deep was about 3° above 1888. The mean humidity, 73·2%, was 14·5% less than last year. The amount of bright sunshine, 153 hours 10 minutes, was more than double that of last year, and rather in excess of the average. The rainfall, 4·152 in., was about an average.

The first week in August was unsettled, rain falling every day, and during 42 out of the 168 hours. Temperature varied from 62·4° to 52·5°. Thunder, accompanied by lightning of moderate intensity, occurred on the 2nd and 5th. The averages were:—Barometer 29·780 in.; mean temperature 57·62°; humidity 81%; total sunshine 29 hours 10 minutes; rainfall 2·528 in.; prevailing winds S.W.

During the second week the unsettled conditions continued, rain falling on six days; from 9 a.m. to 9-30 p.m. on the 14th 1·03 in. fell. Very little sunshine was recorded; the proportion of cloud 9·7 (scale 0—10). The averages:—Barometer 29·827 in.; mean temperature 53·92°; humidity 87%; sunshine 6 hours 15 minutes; rainfall 1·592 in.; wind variable.

W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, August 16, 1889.

Sheffield.

METEOROLOGICAL SUMMARY.

July, 1889.	TEMPERATURE. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for July.* Daily Max.	Daily Min.	RAINFALL. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date	Mean for July* Ins.
Sheffield ...	77°	30th	45°	8th	58°	--	--	2·44	15	0·73	26th	--
Spurn Head.	75°	6th	48°	8th	59°	--	--	1·34	13	0·26	13th	--
York	80°	31st	42°	8th	60°	68	52	1·42	12	0·36	10th	2·57
Barrow	73°	31st	48°	6th	58°	--	--	2·82	11	0·86	20th	--
Liverpool ...	78°	31st	48°	8th	59°	66	54	2·01	16	0·52	24th	2·20
Holyhead ...	76°	31st	48°	24th	58°	64	55	2·41	15	0·85	10th	2·32
Oxford	80°	30 h	44	19th	60°	70	54	2·06	14	0·58	12th	2·51
London	80°	31st	48°	24th	62°	73	54	1·92	18	0·47	21st	2·17

* The means of Temperature and Rainfall for July are for 15 years.

July 16 to August 17, 1889.

PRESSURE.

On July 16th the barometer ranged between 29·8 in. and 29·0 in. in all parts of the kingdom, and had risen to 30·0 in the W. on the 17th, remaining the same on the 18th, but falling slightly on the 19th. On the 20th it had fallen to 29·6 in. in the W. and 29·8 in. in the E., with a further fall on the 21st, when a depression with readings at 29·4 in. was over the northern parts of the country. Pressure recovered generally on the 22nd, but was still low, though slowly rising on the 23rd. On the 24th a depression in the N.W. caused a further fall, and the depression travelled slowly over the country on the 25th, pressure recovering again on the 26th, when the barometer ranged between 29·6 in. and 29·9 in. It continued to increase on the 27th, and the barometer was between 29·8 and 30·0 in., the isobars running from N. to S., and on the 28th it was high but falling slightly, and was steady and above 30·0 in. till the end of July. On August 1st it was 29·9 in. in nearly all places, but fell to 29·6 in. in the N. on the 2nd, remaining at 29·9 in. in the S.; and there was a further fall on the 3rd, but a gradual rise on the 4th, but it was still below 30·0 in. On the 5th the barometer again gave way, and the centre of a depression with readings at 29·4 in. was over the northern part of the kingdom on the 6th, the barometer rising in the S. The depression passed away on the 7th and the barometer steadily rose, and was above 30·0 in. on the 8th, but gave way once more on the 9th and 10th, and was down to 29·5 in. over England on the 11th. It recovered generally on the 12th and 13th, when it reached 29·9 in. in the E. and 30·0 in. in the W., but fell to 29·7 in. in the N. on the 14th, and on the 15th it ranged from 29·6 in. in the N. to 29·9 in. in the S., and was slowly rising.

THE WEATHER.

During the week ending July 20th the weather was very changeable and rather cold. Thunderstorms occurred frequently during the early part of the week, and during the middle of the week the weather improved somewhat, but became showery and unsettled again towards the end. There was rain on six days at Liverpool, five at Sheffield, Spurn, and London, four at York, Holyhead, and Oxford, and three at Barrow. From the 21st to the 27th the weather showed no improvement, but was cool, changeable, and unsettled, with thunderstorms in many parts of England. There was rain on six days at London, five at Sheffield, York, Barrow, and Oxford, four at Spurn and Holyhead, and three at Liverpool. The following week, from July 28th to August 3rd, there was a decided change, the weather becoming fine and warm, and the maximum temperature exceeded 85° in many places. On August 1st and 2nd there was rain in a few places, and thunderstorms at Cambridge and London, but the next day the weather again became fine and clear. There was rain on four days at Liverpool, three at London, two at Sheffield, York, Barrow, Holyhead, and Oxford, and one at Spurn. From August 4th to 10th the weather was of a very changeable, unset-

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tled character—intervals of bright, warm sunshine alternating frequently with heavy showers, and occasionally cold nights. There was rain on seven days at Sheffield, Spurn, York, and Barrow, six at Liverpool and Holyhead, five at London, and four at Oxford. During the next week, from August 11th to 17th, the weather continued in a showery, changeable condition, but the showers were not so frequent and heavy, and towards the end of the week the air became much warmer. Rain fell on five days at Spurn and Barrow, four at Liverpool and Holyhead, and three at Sheffield, York, London, and Oxford.

SUN SPOTS.

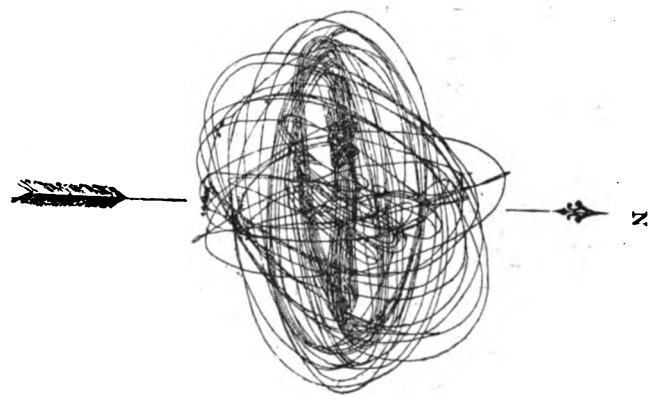
There has been considerable increase in solar activity during the month ending August 15th. On July 16th there was a straggling group of spots past the centre towards the W., consisting of two triangular groups with faint spots connecting them, the whole covering a considerable area. There was also a large irregular elliptical spot nearer the eastern limb, surrounded by large and well-defined penumbra. On the 17th the two triangular groups had become smaller, the first of them consisting of one spot only and the other of two, the smaller connecting spots having disappeared, and the elliptical spot remained the same. On the 18th the same spots were visible, but smaller, and the elliptical one had four small scattered spots above it outside the penumbra. The sun was not again seen till the 25th, and it was then spotless, and remained so till the 30th. On the 31st there were three spots to the N. of the disc, round and not very large, and these were still there on August 3rd, when there was also a group of seven or eight spots below the equator and nearer the eastern limb, and on August 5th there was a group of spots almost in a straight line, enclosed in a well-marked penumbra, followed by some irregular smaller spots, to the E. of which was a well-marked conical spot with small ones below it to the S. On the 6th the same spots were visible, and again on the 8th and 9th, when the first group was approaching the western limb. The weather interfered with further observations till the 15th, when there were two groups of spots close together near western limb, the first consisting of three spots one above the other, and the second of four small spots in an irregular semi-circle. There was also a small round spot near the centre of the disc.

E. HOWARTH, F.R.A.S.

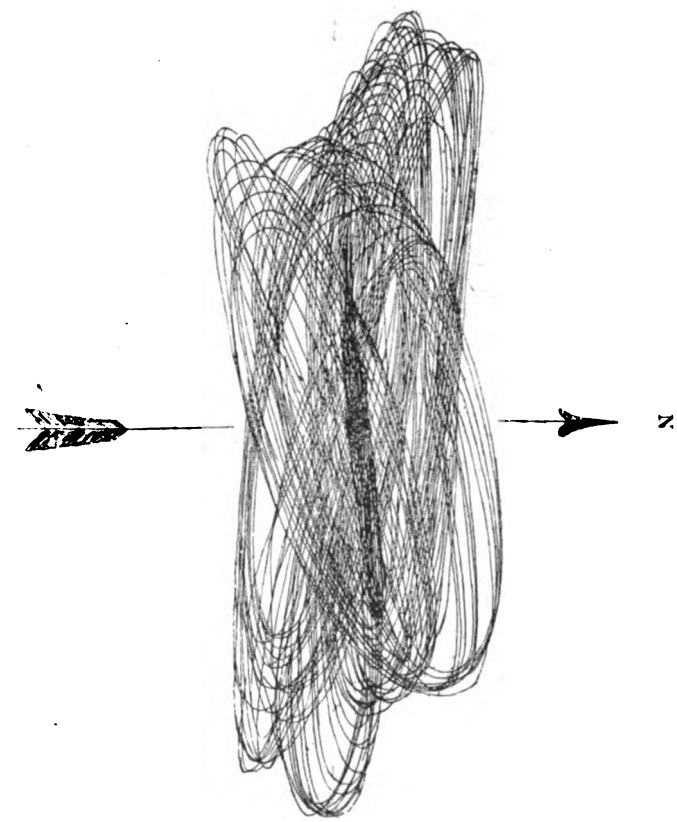
Museum and Observatory, Sheffield, August 20, 1889.

Earthquake in Manila.

THE REV. H. H. HIGGINS, M.A., of Liverpool, sends us the following extract from a letter from his son respecting an earthquake that occurred in Manila on the 26th of May last at about two in the morning:—"The heat since April 1st has been most intense, the observatory having registered a higher temperature than has been known for many years. The 25th of May was exceedingly oppressive and the atmosphere was exceedingly heavy, and the appearance of the sun somewhat hazy, the sun thermometer marking 162° Fahr. The watcher in charge of the seismological department says:—The forerunner of this imposing phenomenon was a muffled sound, something like that of distant cannonading. Then the pendulum of the seismograph here was released. The oscillations having commenced, the pendulum marked a sinuous line describing arcs of but small amplitude. This continued for five seconds, when there was a notable increase, which gradually augmented for a space of eight seconds. The curves now showed the greatest irregularities in the motion of the pendulum, oscillating in all directions without uniformity either as to time or to the amplitude of the oscillations, the greatest of these measuring 5° 11·55 N.N.W. to S.S.E. This perturbation lasted 14 seconds. From this instant the lines became normalised, this being brought about by a fresh shock which changed the axis of the curves from N.E. to S.W., the arc of the maximum amplitude being 5° 43·22. After 30 seconds' duration a more intense shock changed the axis of the oscillation, its course being E.S.E. to W.N.W., oscillating an arc 5·55·19. From this moment the motions



were uniform, the amplitudes decreasing successively. The seismograph for marking the vertical trepidations registered a maximum of four millimetres. The tide gauge showed a decrease in the tide of 10 centimetres, and an increase of something over this. More slight shocks were felt after this at 4 a.m., 4·30 a.m., and 1·24 p.m. The cryptophone trans-



mitted sounds similar to hard knockings. These were observable up to mid-day on the 26th. Since then to date the shocks have been almost continuous, although most of them have not been felt by the general public."

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List of the Plants of the Isle of Man.—Part IV.

By the Rev. Samuel Gasking, B.A., F.G.S.,

Corresponding Member of the Isle of Man Natural History and Antiquarian Society, Member of Council of Liverpool Naturalists' Field Club, &c.

Order 80.—*Coniferæ.*
Pinus sylvestris—Scotch fir.
Taxus baccata—Yew.

Order 81.—*Orchidaceæ.*
Listera cordata—Heart-leaved tway-blade.
Do. ovata—Common do.
Orchis mascula—Early purple orchis.
Do. latifolia—Marsh orchis.
Do. maculata—Spotted palmate orchis.
Habenaria bifolia—Lesser butterfly orchis.
Do. viridis—Frog orchis.

Order 82.—*Iridaceæ.*
Iris pseudacorus—Flag.
Crocus vernus—Purple spring crocus.

Order 83.—*Amaryllidaceæ.*
Narcissus pseudo-narcissus—Daffodil.
Galanthus nivalis—Snowdrop.

Order 84.—*Liliaceæ.*
Allium ursinum—Ransoms.
Scilla verna—Vernal squill.
Hyacinthus nonscriptus—Wild hyacinth.
Polygonatum multiflorum—Solomon's seal.

Order 89.—*Alismaceæ.*
Alisma plantago—Great water plantain.
Do. ranunculoides—Lesser do.
Triglochin maritimum—Seaside arrow grass.

Order 90.—*Naiadaceæ.*
Potamogeton natans—Broad-leaved pond-weed.
Zostera marina—Broad-leaved grass-wrack.

Order 91.—*Lemnaceæ.*
Lemna minor—Lesser duckweed.

Order 92.—*Araceæ.*
Arum maculatum—Lords and ladies.

Order 93. *Typhaceæ.*
Sparganium simplex—Unbranched burweed.
Do. ramosum—Branched do.

Order 95.—*Juncaceæ.*
Narthecium ossifragum—Lancashire bog asphodel.
Juncus communis—Common rush.
A. conglomeratus.
B. effusus.
Do. maritimus—Lesser sea rush.
Do. acutiflorus—Sharp-flowered jointed rush.
Do. bufonius—Toad rush.
Do. squarrosus—Heath rush.
Luzula sylvatica—Great hairy wood-rush.
Do. pilosa—Broad-leaved hairy do.
Do. campestris—Field do.

Order 96.—*Cyperaceæ.*
Schœnus nigricans—Black bog-rush.
Blysmus rufus—Narrow-leaved blysmus.
Scirpus maritimus—Salt marsh club-rush.
Isolepis setacea—Bristle-stalked mud-rush.
Do. Savii—Savi's mud-rush.
Eriophorum vaginatum—Hare's tail cotton grass.
Do. polystachyon—Common do.
A. angustifolium.
Carex pulicaria—Flea sedge.
Do. pauciflora—Few-flowered do.
Do. ovalis—Oval-spiked do.
Do. remota—Distant-spiked do.
Do. vulpina—Great do.
Do. arenaria—Sea do.
Do. vulgaris—Common do.
Do. pendula—Great pendulous do.
Do. pilulifera—Round-headed do.
Do. hirta—Hairy do.
Do. flava—Yellow do.
Variety 2.—*Œderi.*
Do. distans—Loose do.
Carex binervis—Green-ribbed sedge.
Do. lævigata—Smooth-stalked beaked do.
Do. punctata—Dotted-fruited do.
Do. sylvatica—Pendulous wood do.
Do. ampullacea—Slender-beaked bladder do.

Order 97.—*Graminæ.*
Phalaris canariensis—Canary grass.
Phleum arenarium—Sea cat's-tail do.
Alopecurus pratensis—Common fox-tail do.
Agrostis vulgaris—Fine bent do.
Ammophila arundinacea—Mat do.
Calamagrostis epigejos—Wood small-reed.
Aira flexuosa—Waved hair glass.
Avena fatua—Wild oat do.
Arrhenatherum avenaceum—False oat do.
Holcus lanatus—Meadow soft do.
Schlerochloa loliacea—Wheat meadow do.
Poa annua—Annual meadow do.
Do. pratensis—Smooth do.
Cynosurus cristatus—Common dog's tail do.
Dactylis glomerata—Rough cock's-foot do.
Festuca elatior—Tall fescue do.
Brachypodium sylvaticum—Slender false brome do.
Triticum repens—Couch do.
Lolium perenne—Rye do.
Do. temulentum—Bearded darnel.
Nardus stricta—Common mat-grass.

Order 98.—*Filices.*
Ceterach officinarum—Scale fern.
Polypodium vulgare—Common polypody.
Do. phegopteris—Beech fern.
Do. dryopteris—Oak fern.
Allosorus crispus—Parsley fern.
Polystichum aculeatum—Prickly shield fern.
C. angulare.
Lastrea thelypteris Marsh fern.
Do. oreopteris—Mountain fern.
Do. filix-mas—Male fern.
Do. spinulosa—Spinulose buckler fern.
Do. dilatata—Dilated buckler fern.
Do. æmula—Hay-scented buckler fern.
Athyrium felix-femina—Lady fern.
Asplenium trichomanes—Maidenhair spleenwort.
Do. marinum—Sea do.
Do. lanceolatum—Lanceolate spleenwort.
Do. adiantum-nigrum—Black do.
Do. ruta-muraria—Wall rue.
Scolopendrium vulgare—Hart's tongue.
Blechnum boreale—Northern hard-fern
Pteris aquilina—Brake.
Adiantum capillus-veneris—True maiden hair.
Hymenophyllum Wilsonii—Scottish filmy fern.
Osmunda regalis—Royal fern.
Botrychum lunaria—Moon-wort.
Ophioglossum vulgatum—Adder's tongue.

Order 90.—*Lycopodiaceæ.*
Lycopodium clavatum—Common club-moss.
Do. alpinum—Alpine do.
Do. selago—Fir do.

Order 100.—*Marsileaceæ.*
Pilularia globulifera—Creeping pill-wort.

Order 101.—*Equisetaceæ.*
Equisetum maximum—Great water horse-tail.
Do. arvense—Corn horse-tail.
Do. sylvaticum—Wood do.
Do. limosum—Smooth naked do.

Note.—The greater number of these plants do not occur in any list with which I am acquainted. The majority have been collected by me at different times and carefully examined. As regards many of the critical plants I have had the ready help of Mr. Robert Brown, the botanical referee of the Liverpool Naturalists Field Club; and it is through his kindness, along with the favours shown me by other friends, that the list appears so large as it is. The localities are withheld for the present. I have adopted the arrangement and nomenclature given in "The Botanist's Pocket Book," by Mr. W. R. Hayward. S. G.

Societies and their Summer Work.

ALTHOUGH this is the season when many of the science teachers and their students are seeking fresh stores of health and taking a well-earned recreation in many directions away from their accustomed spheres of labour, yet the energies of most of our scientific societies and field clubs seem in no way diminished, to judge from the numerous reports of continued activity which reach us. The weather during August in many parts of the country has not been altogether what is usually associated with the hottest month of the year; still opportunities which have occurred for enjoying nature in her finest aspect under conditions unattainable at any other season, seem to have been generally made the most of by the members of the different societies, of whose doings we again present a brief record.

The marine dredging expedition of the Leeds Naturalists' Club and Scientific Association, along the coast of Yorkshire from Scarborough to Filey, was most successful, and, in view of the increasing popularity of this kind of excursion in other parts of England, we shall probably next summer hear of many more such sea expeditions. The Hull Geological Society spent their bank holiday in exploring the coast sections at the southern end of Filey Bay. The Field Naturalists' Club attached to the Leeds Co-operative Society has also been active, and amongst the most enjoyable rambles lately held were the excursions to Temple Newsam and to Ingleton. The Sewage Works of the Leeds Corporation at Knowsthorpe were also visited by the members. The Yorkshire Naturalists' Union held their eightieth meeting at Harrogate. The reports of the various sections were most enthusiastic on the results gained of observations made on this occasion. In connection with the Huddersfield Technical School, Mr. Edward Brooke, J.P., and party held a geological excursion to Conisborough, during which some fine sections in the Magnesian Limestone were inspected. The venerable Abbey of St. Hilda at Whitby formed the scene of an interesting visit from the Yorkshire Archæological and Topographical Association, during which the history of this fine monastic ruin was eloquently narrated by Mr. St. John Hope, F.S.A.

The Liverpool Geological Association betook themselves on Bank Holiday to Chirk, and studied one of the finest carboniferous limestone localities in North Wales. The Science Students' Association have held meetings at Thurstaston and Helsby, and at Formby. The Naturalists' Field Club have also held some successful "outings," of which we are enabled to give a fuller report in another column.

Amongst Manchester societies we have to record an exceedingly enjoyable excursion which was made by the scientific students of that city to Whalley and the Kettleshulme Valley; and on another occasion the ever-fresh beauties of Ashwood Dale and Buxton were admired by a large party of members. The Manchester Geological Society have visited the scene of the subsidences in the vicinity of Northwich, which were examined under the guidance of Mr. Thomas Ward, J.P., who is universally recognised as "the man who knows all about salt."

The Society of Antiquaries of Lancashire and Cheshire have made visits to Hand Hall, where the ancient building known as the "Old Barn" was the subject of some discussion. Radcliffe, with its old church and "Fair Helen's Tower," attracted a party of the antiquaries on another date. The Amateur Photographers have combined evening meetings with several outdoor excursions for "camera practice." At one of these meetings the subject of "Exposure and Development" was exhaustively treated by Mr. Steventon.

The Microscopical Society have been by no means behind their *confreres* in the search after nature "afield or afloat," and several rich stores of microscopic life have been brought home from the excursions to Boggart Clough and White Moss. Finally, the Field Naturalists' have evidenced their energetic studies by visits to Edensor and Chester, on both of which occasions a good amount of botanical work was done.

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Societies.

British Association for the Advancement of Science.—The following preliminary programme has been issued for the Newcastle-on-Tyne meeting, 11th to 19th September:—General and evening meetings, open to members of the Association only: Wednesday, 11th September—President's Address. Thursday, 12th—Reading of Papers in the various sections; *Soirée*, given by the Mayor and Corporation of Newcastle. Friday, 13th—Reading of Papers; Lecture on the "Hardening and Tempering of Steel," by Professor Roberts-Austen, F.R.S., F.C.S. Saturday, 14th—Reading of Papers; Half-Day Excursions; Conferring of Degrees at Durham University and Invitation Luncheon to 200 members of the British Association; Lecture to the Working Classes on the "Forth Bridge," by Benjamin Baker, Esq., C.E. Monday, 16th—Reading of Papers; Lecture on "How Plants Maintain Themselves in the Struggle for Existence," by Walter Gardiner, Esq., M.A., F.L.S. Tuesday, 17th—Reading of Papers; *Soirée*, given by the Local Executive Committee. Wednesday, 18th—Concluding General Meeting. Thursday, 19th—Whole Day Excursions. No special invitation will be required to either of the *soirées*, but members will be admitted on presentation of their tickets. On Sept. 11th, 12th, and 13th the Durham, Northumberland, and Newcastle-upon-Tyne Botanical and Horticultural Society will hold its Autumn Flower Show in the Leazes Park. Members of the British Association will be admitted free during the whole of Wednesday *only*, on presentation of their tickets of membership. The Committee of the Antiquarian Society the Free Public Library, the Literary and Philosophical Society, and the Natural History Society have opened their rooms free to members of the British Association during the meeting. By the kind permission of the owners, all the principal works in Newcastle and on the Tyne have been thrown open to the inspection of visitors during the meeting. Details as to days and time will be given in the local programme. The following books are in course of preparation:—Historical and Topographical Handbook to Newcastle-on-Tyne and District, edited by Rev. J. Collingwood Bruce, LL.D., D.C.L., F.S.A.; Handbook to the Geology and Natural History of Northumberland and Durham, edited by Professor G. A. Lebour, M.A., F.G.S.; and Handbook to the Industries of Newcastle and District, edited by Wigham Richardson, Esq. Tickets for the meeting may be obtained of the Local Secretaries at Newcastle-upon-Tyne, at the Office of the Association, 22, Albemarle Street, London, W., or on application by letter to the General Treasurer, Professor A. W. Williamson, British Association, 17, Buckingham Street, London, W.C. On making this application annual members will be so good as to send the amount of their annual subscription (£1), together with the invitation circular. Life members are requested to return their invitation circulars on making application for tickets. On and after Monday, September 9th, members and persons desirous of becoming members or associates or of obtaining ladies' tickets must make application in the reception room, Newcastle-upon-Tyne. Without a proper ticket, obtained as above, no person will be admitted to any of the meetings.

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British Archæological Association.—The forty-sixth annual congress of this Association was opened at Lincoln, on 29th July, the Mayor of Lincoln (Mr. W. Watkins) and the Corporation holding a reception of the members, and afterwards entertaining them to luncheon. In responding to the toast of "The British Archæological Association," proposed by the Mayor of Lincoln, the Earl of Winchelsea gave a highly-interesting address, in the course of which he succinctly reviewed the history of Lincoln from the time of the Roman era to the present, and concluded by affirming that the Association had shown that it had a proper place in the practical work of the nineteenth century; and it was entitled to the gratitude of the nation for the work it had performed in the past, in the preservation of many monuments of incalculable value. The members then inspected various objects of archæological interest in the city. In the second day's proceedings, on Tuesday, the members first visited the Stonebow and Guildhall, and inspected the seals, documents, and insignia of the Corporation, an interesting description of the maces, swords, &c., being given by Major Lambert, the documents being described by Mr. W. de Gray Birch, F.S.A, of the British Museum. The old Grammar School (Grey Friars) was then visited, and *en route* to the Cathedral two Norman houses on Steep Hill were inspected. Precentor Venables gave a description of the Cathedral. After luncheon the Norman castle was inspected, and visits paid to Roman remains in Bailgate, the Newport Arch (an old Roman gateway), remains of the Roman city walls, the Bishop's Palace, and various other places of interest in the city. In the evening there was a meeting in the School of Science and Art, and papers on the following subjects were read:—"Somerton Castle and its Royal Prisoner," by the Lord Bishop of Nottingham; "Visitation of Lincoln Cathedral in 1436-7," by the Rev. A. R. Maddison; "A Roman Lanx found at Lackenham Fens, Suffolk," by Mr. Hy. Prigg; and "Mediæval Masonry," by Mr. Chas. Lynam. The members of the association went by train on Thursday to Boston, and visited the fine parish church of that town. The tower of this fine old church, which is known as Boston Stump, was commenced in 1309, but the nave and chancel are believed to have been founded a century earlier. Before the erection of the tower, it is recorded that the four angles of the church were adorned with turrets, similar to those of King's College, Cambridge. The tower and roofs are in the Perpendicular style of architecture, and the remainder of the building is in fine decorated work. During the present century the church has been restored, both externally and internally; in 1846-7 £3891 was expended in external renovation, and in 1853, under the direction of Sir G. G. Scott, £5918 was spent in internal renovation. The Town Hall, an ancient Gothic building, the old warehouse in Spain-lane, the Grammar School, endowed by Queen Mary in 1554, and the Hussay Tower were also inspected. Luncheon having been partaken of at Shodfriar's Hall, the party left for Tattershall, where the remains of the famous castle were visited. This castle was erected about 1440 by the Lord Treasurer Cromwell. It was at one time a formidable fortress, but was dilapidated in the wars between Charles I. and his Parliament. The church was also visited, and the party then returned to Lincoln. In the evening a paper was read on "Roman Discoveries in Lincoln."

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Royal Horticultural Society.—An exhibition of garden vegetables, fruits, and salads is being organised by this society. It will be held at Chiswick, commencing on September 24, and will be combined with a conference of practical cultivators, having in view the improvement of products of the vegetable garden. Committees of experts will report upon those considered the best adapted for general cultivation. The following subjects will be introduced:—"Asparagus," by Mr. Shirley Hibberd; "Winter Salads," by Mr. Norman; "Food of Vegetables," by Mr. J. Wright; "Improvement of Peas," by Mr. T. Laxton; "Potatoes," by Mr. A. Dean; "Vegetable Supply throughout the Year," by Mr. I. Smith. On the opening day the proceedings at Chiswick will be followed by a gardeners' dinner; on the second day the reports of committees will be presented, and on the third day the improvement of the products of the vegetable garden will be discussed. Mr. Harry Veitch is appointed chairman and Mr. Shirley Hibberd vice-chairman.

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British Medical Association.—The fifty-seventh annual meeting of this Association was held at Leeds, commencing on Tuesday, 13th August, under the presidency of Mr. C. G. Wheelhouse, who delivered an address. A reception was given on the Wednesday by the

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President and Senate of the Yorkshire College, and in the evening there was a *conversazione*. At the concluding meeting an address was given on psychology by Sir James Crichton Browne. Several excursions to places of interest in the neighbourhood enlivened the ordinary routine business of the annual meeting.

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KENT ARCHÆOLOGICAL SOCIETY.—On July 31st this society held its annual meeting at Dartford, extending over two days. At the general meeting Lieut.-Col. Edwin Hughes, M.P., occupied the chair. The report, read by Canon Scott Robertson, hon. secretary, stated that the society's position was flourishing, a balance of £700 standing to its credit at the bank. The 18th volume of *Archæologia Cantiana* would be issued this autumn. The society supported the movement for a closer union of local archæological societies, regarding which a congress was held at Burlington House. A map of Kent, marked with the sites of all the discoveries, had been compiled by Mr. George Payne. During the year interesting discoveries had been made at Canterbury and Rochester. After the business the members proceeded to the Parish Church at Dartford, which is noted for its antiquities, including a very fine series of ancient monumental brasses. The tower was an early example of Norman work. It was probably originally erected as a defensive stronghold, commanding the ford over the river Darent. They afterwards visited "May Place," an old residential manor, part of which dates from the time of Elizabeth. Papers were read during the congress by Mr. F. C. J. Spurrell on "Prehistoric Antiquities of Our District;" on "Dene Holes;" and "Roman and Saxon Remains from Dartford and its neighbourhood." The interesting and ancient hostelry, the "Bull" Inn, at Dartford, was also visited. This inn is one of the few now remaining possessing the old court yard and galleries in an almost perfect condition, and is a fine example of mediæval domestic architecture.

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LIVERPOOL ENGINEERING SOCIETY.—The members of the Liverpool Engineering Society, who were the guests of Mr. George Farren, J.P., proceeded on the steamer "Lady Bessie" from Carnarvon, on 24th June, for the purpose of inspecting the Welsh Granite Company's quarries. On the voyage the Carnarvon Bay lightship was visited, and, upon the invitation of the captain, the steamer's party boarded her and inspected the machinery. The steamer's course was then directed towards Llanaelhaiarn, the galleries of the Welsh company's granite quarries being now and then plainly seen. After luncheon, when the steamer was off Llanaelhaiarn, Mr. C. A. Darbishire, on behalf of the Engineering Society, returned thanks to Mr. George Farren for the hospitable manner in which he had received the society, both ashore and afloat. Mr. Farren briefly acknowledged the compliment. After landing, the party proceeded to inspect the works connected with the quarries. Mr. Farren explained the improvements which the company had effected during his connection with them as engineer and manager. From the jetty the party proceeded in trams drawn by a locomotive to the company's workshops, fitting shops, and stone-breaking machinery, afterwards ascending a steep incline, 800 yards in length, stopping on the first landing, known as the Pont Isa, to witness the process of block cutting and stone dressing. Blasting operations at this gallery had immediately preceded the arrival of the excursionists, and an opportunity was thus afforded them of seeing wonderfully large blocks of granite of an exceptionally fine quality. Other galleries were visited. The party was afterwards photographed by Mr. Kinsley, of Carnarvon, and after a scramble to the brow of the mountain, whence a magnificent prospect was obtained, the party commenced the descent, reaching the base of the incline at half-past four o'clock. The return voyage of the "Lady Bessie" was thoroughly enjoyed. Carnarvon was reached about 7 o'clock, and, having landed, the excursionists proceeded by the night mail to Liverpool.

LIVERPOOL GEOLOGICAL ASSOCIATION.—On August Bank Holiday the members of the Association joined in an excursion to the Chirk neighbourhood. The first object of interest on the programme was the section exposed at Mr. J. C. Edwards's terra-cotta works, Penybont. This is in the Permian Red Marl, and the thickness and even character of the clay is very noteworthy. It has a bright red colour, and when exposed to the weather is easily broken down and made available for terra-cotta and bricks. Capping the clay on one side of the quarry was seen a conglomerate drift of a few feet in thickness, and possessing great interest to students of glacial geology. The boulders in the lower part of this section seemed to rest where they had been stranded during the Ice Age, but in the upper half they appeared to have been water-worn, so that there the material assumed the character of a coarse gravel, from which the first material had probably been removed by the waters of the Dee. Two very large boulders of felsite were very conspicuous on the ground, and standing by one of these the secretary of the association found a fitting opportunity to give a brief account of boulder dispersion, as set forth in Mr. D. Mackintosh's classical researches in that direction. The nearest centre of dispersion to that neighbourhood was the Arenig district, and from that tract large boulders of felsite were found radiating outwards towards the east as far as Ruabon neighbourhood, and south-east as far as Birmingham. Other centres of dispersion were Criffel, Shap Fells, and the Lake District generally. From those northern regions had come various granites and volcanic rocks, which were found pretty freely distributed over Lancashire, Cheshire, and Staffordshire, and it would appear that on the eastern boundaries of North Wales the northern erratics were often found lying side by side with those of Arenig. The only massive boulders seen in the Penybont section were those of felsite, presumably from North Wales, whilst of small boulders there were numberless representatives of Silurian grits, such as might also have been derived from North Wales, or possibly in some instances from the Lake District. A block of pink syenite, about 12 inches in diameter, seemed to be an unmistakable northerner, and chips of both this rock and the felsite were preserved for microscopical examination. The section is certainly a highly-instructive one, and deserves a more exhaustive examination than we could give it. We hope that our local boulder committee will endeavour to take a census of the included erratics, so that we may be able to trace them to their homes. The second part of the day's programme consisted of a drive to Glyn Ceiriog, and an examination of the granite and chert quarries there. Mr. Charles Griffith, on behalf of the quarry directors, accompanied the party, and on arrival at Glyn entertained the geologists to lunch. The Lower Silurian rocks examined have a general dip to the north, and form steep escarpments on their southern sides as they outcrop from beneath the Wenlock group. A band of hydraulic limestone is passed, then come great masses of felsite, and then a mass which is recorded on the survey maps as greenstone. Coarsely crystalline, and akin to diorite in mineral composition, the hill which it builds up is quarried for road metalling and "setts." Technically spoken of as a granite, its hardness and roughness make it valuable for the purposes mentioned. The felsites, which are very finely crystalline, and pass from white to blue in colour, are used as "runners" in the wheels used for grinding potters' clay. Used for this purpose, the material is technically known as a chert. The felsites are of course massive lava sheets interbedded with Lower Silurian sediments, but the relation of the greenstone to its neighbours was not made out. Furnishing specimens of acid and basic rocks close together, the neighbourhood may be regarded as a good one for collecting rock species, as well as for noting illustrations of important geological principles, and learning valuable economic lessons.

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MANCHESTER GEOLOGICAL SOCIETY.—The following paper was read by Mr. Charles Roeder at a recent meeting:—"A New Archæological

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Discovery on the Ship Canal at Sticking Island."—"I beg to place before you a discovery, having archæological interest, which I made while examining the Barton section. The leaf-beds which rest on the coarse gravels of the latter here, directly again in the pebble beds of the Trias, the floor of which bears the most striking evidence of moraine and glacial action, in the shape of curvature and canalineaton, traceable straight along from Mode Wheel, were the Trias beds break out. I say the leaf-beds have been already made the subject of examination and discussion, attention being first drawn to it by Mr. Leader Williams, while Mr. Thompson gave a list of the plants and trees which gave rise to them, and subsequently they rose into further eminence by the discovery on Wednesday last of an ancient canoe, found in the same horizon. It would be difficult to affix yet any age to which this relic of early civilisation has to be referred. Another similar canoe has been, as is already known, found during the Ribble navigation excavations at Preston, and it would be well to see what co-relation exists between them, and if the g ological evidence shows, and what similarity of disposition, if there is a structural relation. Also, if the canoe discovered some time ago near Peel, Isle of Man, falls into the same category. Until we have some better data it is a mere pretension to speak of pre-Roman with reference to the age of the canoe in question. It may be pre- or post-Roman. Meanwhile a very careful search may help us on, and yield collateral finds to fix a secular basis for a probable period. So far we have been less fortunate than Preston with its immense finds of the former fauna; what little has been discovered on the canal section consists, it appears, of some antlers from near Warburton. I have looked so far in vain from Old Trafford onwards for any stone-hammers, flint tools, whorls, or skulls and bones, but, as a compensation, found in the same silt and leaf-beds at Sticking Island, as above mentioned, another artifast, consisting of a wooden comb, which I beg to place before you for examintion, and proceed to describe. It is 3⅜ in. long, 1⅞ in. high, and ⅛ in. thick. It has teeth on both sides; the upper narrow row has been, it appears, destroyed by the action of fire. Its indentation is 2¼ in. long, and had, when complete, 55 teeth; the under row still bears eight entirely preserved teeth, at the origin ⅛ in. thick, cut to a point and nail shaped; the edges are not sharp, but, all angles cut away, each tooth measures 1⅛ in. The two ends of the comb are curving down, the wood used is of a soft nature, and does not appear to be oaken; the comb is perfect and not in any way injured with the exception of the upper teeth, which, as said before, are destroyed by the action of fire. Neither is it sculptured or carved, but quite smooth. Wooden combs are very rarely found, most having perished, as a consequence of the easy destruction of such small articles, of material so easily decomposed. The nearest shape to the one on the table is the Judian comb for scalp locks, which has eight teeth, and an engraving of which will be found in Hume's *Ancient Meols, or Some Account of the Antiquities found near Dove Point on the Sea Coast of Cheshire, 1863*. Combs of bone and ivory have been now and then found in British and Anglo Saxon barrows, as for example at Barrow Furlong, Northamptonshire. The Irish rock combs are different. We have also the double comb, mentioned in the *Jonventarium Sepulchrale*, and the mane-combs, which, as the *Shuttleworth Account* tells us, cost, anno 1616, 4d., and a single curry comb 6d., a double 1s. 6d. So far, then, the excavations have brought up a canoe, a quern, and a wooden comb, and we hope that our list may be swelled further. I may, perhaps, be allowed to add a word and a plea for these valuable finds. Unfortunately Manchester is deprived of the blessing of an archæological museum, that is, a place specially and essentially devoted to the preservation of historic and prehistorical relics and monuments, and in this regard stand behind other towns, much to our grief. The consequence is that many prehistoric and historic articles of the greatest value become lost, or scattered, or go away. Owens College, as I know to my own cost, treats these things but indifferently, and they appear to be admitted on mere sufferance; the new Museum, so far, has not made preparation or granted any facilities and space for such finds; and it is time to ask if we must look quietly on and let things *laisser aller*, or obtain some proper and prompt commissions and assign a permanent home in the College or elsewhere for these relics, illustrative of our country, and which we can ill afford to forego."

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YORKSHIRE GEOLOGICAL AND POLYTECHNIC SOCIETY.—The annual meeting of this society was held at Doncaster, on August 14th. Lord Halifax presided, and amongst the others present were Professor Lupton (Leeds), Mr. T. Atkinson (Selby), Mr. T. H. Gray (Leeds), and several friends of Lord Halifax. On the motion of Mr. Atkinson, £5 was awarded to the Rev. G. R. Vine, of Sheffield, for his services in geological science. The Rev. J. Stanley Tute read a paper on "The Burrows of a Stone boring Shell Fish in the Permian Sandstone near Wormald Green Station." The Rev. G. R. Vine did not attend, but some notes of his on British eocene polyzoa, and a monograph of Yorkshire carboniferous and permian polyzoa, were read by the secretary. Mr. W. Cheetham described a boulder which had been found at Horsforth while levelling a piece of ground for lawn tennis. The boulder was about five tons in weight, and remarkable for having engraved upon it a series of cup and ring marks similar to those known for a considerable time at Rombald's Moor. The markings were attributed to people earlier than the Romans, and being similar to other cup and ring markings found in various parts of the world are thought probably to be indications of some forms of religious belief. Among other papers read was one by Professor Lupton, "Notes on Gold, Salt, and Slate Mines in Great Britain," illustrated by the oxyhydrogen lantern.

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YORKSHIRE NATURALISTS' UNION.—At the recent meeting of the Yorkshire Naturalists' Union at Harrogate the geologists determined that, instead of studying the district to the south-east of that town, they would examine the locality to the north and north-west. By this means three important geological formations could be seen to advantage, viz., the lower magnesian limestone of the Permian system, and the Millstone Grits and the Yoredale Rocks of carboniferous age. Accordingly, instead of alighting at Harrogate with the rest of the party, the geologists proceeded farther to Nidd Bridge, and there commenced their work. From Nidd Bridge station they took the road to Ripley, on the way examining that remarkable boss of lower magnesian limestone known as Nidd Rock. It is not only remarkable as being an outlier of the Permian rocks, the nearest position of these being some miles away, but more so as it is almost surrounded by one of these terraces of river gravel, which were formed, of course, when the Nidd flowed at a higher level. This is a very fine example of a river terrace. Strangways, in speaking of these terraces, says that "it is a curious fact connected with them that they all occur just above the 100 contour, which is the maximum elevation of the warp clay; and it would appear from this that they were deposited about the same time, and when the lower portion of the Nidd was under tidal influences as far as Walshford Bridge." The limestone here was soft, thickly bedded, and yellowish in colour. The rock, apart from its geology, forms a pleasing picture. They then passed through the quiet and pleasant little town of Ripley, not having time to bestow more than a passing glance at the exterior of its ancient castle and church, but taking the road through Holly Bank Wood on their way to Clint. The scenery along this road was of a charming character. Their visit to Clint was to inspect a section of the Cayton Gill Beds, so inseparably connected with the name of the Rev. Mr. Tute, Vicar of Markington. This gentleman had kindly written informing them of the section, and it certainly is a fine one. It receives its name from the good exposures to be seen in Cayton Gill, a few miles north of Ripley. Geologically it belongs to the third grits of the Millstone Grits series, and its position is between the Plompton

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and the Follifoot Grits. It is a hard, calcareous sandstone, and is highly fossiliferous, the bed being literally one mass of fossils. There were quantities of *Productus semireticulata*, *Spiriferæ*, *Orthis*, stems of *Encrinites*, *Bellerophon*, *Aviculopecten*, &c., and one member found what seemed to be a remnant of *Fenestella*. It was a rich harvest for the fossil collectors, and bags began to acquire weight. There are several other good sections in the neighbourhood, particularly in a quarry at Hampsthwaite and in the railway cutting near the station. Mr. Adams gave an address on the stratigraphy of the whole district, then describing each bed in detail, with localities for sections. He also spoke upon the unique geology of Harrogate, and described the great anticlinal to which is due the prosperity of that town. In answer to a question, it was stated that the rocks they were then travelling over were the third grits, the highest in this district of the millstone grits series. Where, then, were those rocks which we know occur between the Permians and the third grits, viz., the coal measures, the rough rock, &c.? These have been removed by denudation before the Permians were laid down, and although we had had conclusive proof of extensive denudation at Nidd Rock, this was a more remarkable and immeasurably grander example of this familiar geological agency. After other questions had been asked and replied to, the party, invigorated, again proceeded on their way, passing through charming country lanes to Saltergate Hill, and then to Four Lane Ends. The former hill is capped by the Cayton Gill beds, and at both places there are quarries of the same; but as the one at Clint had been so well examined, and time was so limited, it was deemed advisable not to stay. At Four Lane Ends some of the party thought it best to hurry direct to Harrogate, but the remainder determined to carry out the whole walk at first agreed upon, passing over the Saltergate Beck, which has carved its way through the intermediate shales. An ascent was then made to the ridge north of Oak Beck, where there is a section of the Follifoot Grit, the lowest of the Third Grits in this district, and so named because it is so well exposed on the edge of Follifoot Moor, south of the Crimple Valley. These grits also crop out near Harrogate Gasworks, and it will be remembered that upon a former excursion they were noted at Bilton, where the thin seams of coal occur. It may be stated here that the Plompton Grits—the uppermost of the Third Grits—had already been noted by the members during the day; but as these had been previously examined in many other places it was thought best to pass them over upon this occasion. They now descended into the beautiful valley of the Oak Beck, where, at the bridge, another halt was called to recline a little on the fresh greensward, and admire the fine wooded scenery of Birk Crag, the joy of many an artist. Here, too, some geology was done, as an opportunity was presented of viewing a section of the Kinderscout Grit, the lowest of the Millstone Grits. These rocks dip sharply at this place, about 43° north-west. The Kinderscout Grit is now pretty well known to the members from its characteristic pebbles of quartz included, and generally coarse, massive appearance. They soon passed over the great fault which forms the boundary of the Yoredales, and throws the Harrogate roadstone against the Kinderscout Grit. They were shortly, too, on the axis of that famous anticlinal which has attracted all geologists since the days of William Smith, "the Father of English Geology." This is the extreme end of the anticlinal, which stretches across from Clitheroe and Skipton more or less in an easterly direction. As the Government geologists will say, "the Kinderscouts are like a wall on each side of the anticlinal, and afford a key to the whole structure of the neighbourhood." As stated above, these rocks dip at Birk Crag about 43° north-west, but on the south side they dip to the Crimple Valley, that is in an opposite direction, or south-east from 45° to 20°. The rocks bend round to the fault, and at Starbeck dip to the east only about 4°. "From this it appears that the anticlinal of Harrogate dies out to the east, and that there is no great anticlinal ridge of carboniferous rocks below the Permian and Trias."

Leeds Naturalists' Club and Scientific Association.—The "Marine Dredging Expedition," from Scarborough to Filey Bay, although announced to have been postponed, did, however, take place on the 20th July. The party was essentially a working one, with the president of the club (Professor de Burgh Birch, M.D., C.M., F.R.S.E.), as leader, and the following members and friends:—Messrs. M. J. Oliver, M.B., C.M., W. B. Russell, B.A., M.B., F. W. Branson, F.C.S., J. Charters Birch, L.D.S., L. Wilson, R. Cuff, M.B., H. E. Cuff, and Captain Lightfoot. Through the courtesy of Major Woodall, of Scarborough, the steam-tug *Alexandra*, in charge of Mr. John Stephenson, with experienced fishermen, trawling apparatus, &c., was in readiness, and work commenced by letting down the trawl. The course taken first was across the bay, with orders to steam very slowly. In the meantime the tow-net was played out, and tables extemporised to examine specimens upon. A large number of bottles and cases were taken suitable to hold in a roughly classified way the various objects expected to be found. After a little time the tow-net was drawn up, and its contents emptied into a pail of water. It was soon evident from the first haul that numerous specimens of interest had been taken, which were then assorted and placed in jars with preservative media. At length the bay was crossed. The vessel was then stopped, and preparation made for bringing up the "trawl." Very soon about 150 yards of cable was coiled in, and finally the net itself and its varied contents laid out on the deck, then classified, and stored. Another stretch or two across the bay, and the vessel's head was set for Filey. A large number of sea birds were observed on the cliffs and about the shore, including the razor-bill, diver, auk, guillemot, and several species of gulls. At this stage sunshine assisted the operations of the tow-net by attracting to the surface many larval forms of marine life. The white chalk cliffs at Speeton also showed to greater advantage than would have been the case under less favourable atmospheric conditions, and contrasted markedly with the sombre-looking cliffs which extend from Scarborough to Filey Brigg. From this point could be well seen the Castle Rock at Scarborough, and also far beyond the distant coast line in the direction of Whitby. By this time the tow-net and trawl had been examined several times, and Filey Brigg was approached; and being a rocky bottom, the trawl was kept aboard until the middle of the bay was reached, when dredging was continued uninterruptedly for several hours, with abundant results. At six o'clock the trawl was drawn up for the last time, and the vessel's course set for Scarborough. Soon after rounding the end of the Brigg a shoal of porpoises passed to seaward. A little further along the coast, high among the dark cliffs, were seen great numbers of sea birds clustered together, giving a white appearance to the cliff, which may be easily mistaken for a stratum of chalk. By the time nets, &c., were washed, bottles sealed and safely packed, Scarborough was reached, when the first train home was taken, after having spent a most enjoyable day. The following Monday evening's meeting was devoted to the general examination of the results of the above expedition. The president occupied the chair, and there was a large attendance of members present. A short account of the day's dredging was given, and most of the specimens collected were on exhibition. The following fish were recorded:—Turbot, sole, flounder, skate, spotted ray, gurnard, haddock, herring, whiting, and devil-fish. The last-mentioned *lophius piscatorius* was dissected by Dr. Oliver, and a description given. It is found on the coasts of Europe, Western North America, and Cape of Good Hope. *Exo-skeleton*—Skin naked, and coloured like the bottom on which the fish is lying. It has the power of rapidly changing the colour. Processes of skin are attached along the sides of the body, which look like seaweed, and assist in concealing the fish. *Endo-skeleton—Notochord constricted, vertebral centra amphicœlous*, tail *homocercal*; skull completely ossified; pectoral and central fins are articulated so as to assist jaws in seizing food. Three spines on head are developed for anterior dorsal fin. *Circulatory System*—Single auricle

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and ventricle. Bulbus arteriosus is not contractile, and provided with a single row of valves. *Respiratory System*—Gill filaments free on both sides, only attached by inner ends. Gill cover (operculum) large and supported by rays, the opening being below the pectoral fin. *The Swimming Bladder*—Absent. *Nervous System*—Cerebellum large; optic lobes large; cerebral hemisphere small; optic nerves cross. *Eye*—Sclerotic, formed of fibrous tissue, with two cartilages to strengthen it. *Reproductive and Urinary Organs*—There being no cloacas, the oviducts open immediately posterior to the anus. The ureters from the kidneys open into a large bladder, which opens to the surface close to the oviducts. *Visceral Arches and Clefts*—Jaws well ossified; teeth on jaws; palate and pharynx viliform in character; spiracles are absent. *Limbs*—The pectoral fins are small, and placed on the ventral surface. Pelvic fins, much larger, are placed laterally, and but slightly posterior to the pectoral fins. *Alimentary System*—No spiral valve in the intestine. No cloacas, and the pancreas is rudimentary. Mouth very large; stomach large, and very distensible; it is said to sometimes contain a fish nearly as large as the lophius itself. Pylom small, and placed close to the œsophagus. Two diverticula are present at the uppert part of the intestine. An interesting parasite, *Lernentonia Lophii*, was found in the pouches of this creature. Among other exhibits was a white variety of wild strawberry, collected at Spofforth by Mr. W. Nelson.

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LIVERPOOL NATURALISTS' FIELD CLUB.—A most enjoyable day was spent by the club on Thursday, July 18th, at Bolton Abbey. The party, numbering 81, arrived at Bolton Abbey about noon. Some time was spent about the picturesque ruins of the Abbey (which was founded in the year 1151), and then the members made their way along the bank of the river Wharfe to the "Strid." The woods on either side of the rocky stream were the habitats of many interesting plants, the most noticeable being *Campanula latifolia*, giant bell-flower, which was found growing most luxuriantly. At the "Strid," or "Stride," some of the party preferred to return to the abbey grounds, while the more active members followed the stream to Barden Tower. The "Strid" is a part of the river where the channel is narrow and the water rushes down with great force between the rocks; many people have been drowned in attempting to leap over the stream at this place. On the way to Barden Tower *Eupatorium cannalinum*, hemp agrimony; *Thalictrum flexuosum*, meadow rue; *Paris quadrifolia*, herb paris; *Geranium pratense*, blue meadow cranesbill; *Valeriana officinalis*, greater valerian; *Valeriana dioica*, marsh valerian; were gathered, and in a sloping field, by the river, *Scabiosa arvensis*, the pretty lilac scabious; *Gymnadenia conopsea*, sweet scented orchis; and *Sanguisorba officinalis*, common burnet, were welcome additions to the spoils of the day. Crossing the river by the bridge at Barden Tower, the members returned by the opposite bank of the stream to the "stepping stones" at the abbey grounds. The prizes were then awarded for the orders for the day, *Rosaceæ* and *Labiateæ*, Miss Teresa Mackarell, with 15 species; for the greatest number of plants in flower or fruit, Miss Dora Clementson, with 78; bouquet prize, Miss F. Adams; the botanical enigma, *Sambucus nigra*, elder, was solved and the plant found by Mrs. Adamson, Mrs. E. Davies, the Misses M. E. Clementson, F. M. Clementson, Dora Clementson, T. Mackarell, E. M. Wood, and Fannie Adams, Messrs. C. F. Webb, T. Murray Moore, M.D., W. H. Holt and J. Mackarell. The whole party returned to Skipton, where tea was provided at 6-15, all the members being very much pleased with a very successful and enjoyable excursion.——Another field meeting was held at Ashurst Beacon, on Saturday, August 10th. The afternoon was showery and there was a small party, only 30 members being present. From the summit of the hill an extensive and fine view is to be had on a clear day; then, however, very little was to be seen through the misty atmosphere. Tea was provided at Parbold, in the schoolroom kindly lent by the Rev. Father O'Brien, O.S.B. After tea, the prizes were awarded as follows:—Order prize for *Hypericaceæ*, *Caprifoliaceæ*, and *Compositæ*, Miss Hunter, with 20 species; best basket of wild flowers, Miss E. M. Wood; the basket presented by Miss Mackarell received high commendation. The botanical enigma, *Polygonum persicaria*, was solved and found by Mrs. Edwin Davies, Mrs. Wood, the Misses M. E. Clementson, Moss, Emily Jee, Hunter, E. M. Wood, and J. Mackarell, the Rev. S. Gasking, Messrs. R. M. Capon, Chalmers, Martin Schneider, W. H. Holt, and James Mackarell. Very few plants were found, the best being *Parietaria officinalis*, wall pellitory; *Equisetum sylvaticum*, wood equisetum; and *Lamium album*, white dead-nettle. The return journey was made from Parbold, via Burscough, Liverpool being reached by 9-30. There have also been three evening meetings, to Hadlow Road on July 25th; Lydiate, August 1st; and Roby and Gateacre, August 15th, which was the last of these most successful evening excursions for this season.

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WEST KIRBY NATURALISTS' SOCIETY.—The fourth outdoor meeting of this society was held on Saturday, August 10th, at Burton, a little hamlet on the banks of the Dee, about two miles from Neston. On the road to Burton were found large quantities of *Euphrasia officinalis* (the common eyebright), an elegant little plant, with white and purplish flowers, so small yet so perfect that people wondered how so minute a flower could be so simply beautiful. A little further along the road were found *Mentha aquatica*, *Mentha Sylvestris*, *Mentha arvensis*, and the woody nightshade (*Solanum Dulcamara*), or bitter-sweet. Black horehound (*Ballota nigra*) seems to be very common about Burton, and is easily known by its offensive aromatic smell. One specimen of the white horehound was also found. The largest number of plants in fruit or flower was named by Miss Beatrice Ellison. In the two orders of the day, *Rosaceæ* and *Labiatæ*, Miss Peters collected and named 25 specimens. The enigma, which ran as follows:—"Stem erect; leaf oblong ovate, wrinkled, crenate-serrate, cordate at base; flowers in lateral terminal racemes; calyx, upper leaf ovate, lower four-toothed," was correctly solved by *Teucrium Scorodonia*, or wood sage. Miss Mary Ellison gained the bouquet prize.

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MANCHESTER SCIENTIFIC STUDENTS' ASSOCIATION.—Under very favourable conditions the Manchester Scientific Students made an excursion to Whalley for Kettleshulme Valley, the leader being Mr. Joseph Laycock. The route chosen was one that is not much frequented by the general public, and one part of it commanded a fine view of the surrounding country, with its hills and dales, clumps of trees, and scattered homesteads. On the way numerous wild flowers were gathered, including golden rod, St. John's wort, sylvan loose-strife, jasione, knautia, hieracium, campanula, and others. On leaving the valley the party soon found themselves on the Buxton road, and from thence they wended their way through a shady wood to Taxal, and, at the invitation of Mr. D. Smith, visited his cottage garden. Here they saw numerous curious and interesting plants, flourishing in a remarkable manner in an old stone quarry, which had been converted into a garden. Mr. Hyde gave the usual botanical lecture, his subject being "Aquatic Plants," illustrated with specimens brought for the purpose. After the lecture Mr. Charles Bailey addressed the members on the distinguishing characteristics of some of the buttercups and brambles.

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YORKSHIRE LADIES' COUNCIL OF EDUCATION.—Under the auspices of this council a course of five lectures has been delivered by Miss E. P. Hughes, principal of the Training College at Cambridge, on "Slöjd." At the first lecture of the course, Miss Hughes explained that what she wished to prove by her address was that manual labour ought to be introduced into all schools—elementary and high, those for girls and boys. She had three reasons, viz., educational, economic, and social. She explained that slöjd was a special kind of carpentry

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adapted for school children between the ages of 11 and 14 years. The reason that it should not be used for children of an earlier age was that the same tool was used as the carpenter employed. There was, however, a good deal of difference between it and ordinary carpentry. The carpenter looked upon his work as his trade, while slöjd was taught by a teacher for educational purposes. In the course of instruction the knife was used a good deal, because a child almost naturally knew how to handle it. In addition, the models in the slöjd system were graduated, beginning with very small and simple models, and advancing to those which were more complex and required much more time and attention. With regard to the educational advantages of the system, it was first of all very useful in the physical development of the children, owing to the exertion necessary, whilst at the same time the teacher was careful to see that the pupil kept a good position when doing its work. Besides this, the child was taught to use the left as well as the right hand for sawing and planing. There were, too, many mental advantages attaching to slöjd. It taught the child to be observant and attentive, accurate, self-reliant, and persevering. Coming to the economic aspect, Miss Hughes pointed out that it taught the children a love of manual work—an important point, seeing that there was so much in present-day education to make it bookish. It not only inspired respect for manual work, but also for manual workers; and helped to bridge over the gulf which separated the professions and trade. It promoted a love of excellence in manual work, and developed an æsthetic taste, all the models being most beautifully carved. The manual dexterity acquired formed the real connection between slöjd and technical education. Slöjd was not technical education, but the very best possible preparation for it. Its social advantages were, first of all, what she had already mentioned—the joining of head-workers and hand-workers, while enabling uneducated and undeveloped children to appreciate the value of education. How much it was appreciated was shown by the fact that in Sweden the attendance of children at schools where slöjd was taught was always high. The parents readily saw that the teaching would be of advantage to their children.

New and Forthcoming Works on Science.

MESSRS. RIVINGTON & CO. announce a series of new works on engineering, dealing with the various branches of railways, breakwaters, docks, &c., by eminent practical engineers, under the general editorship of the author of *Notes on Building Construction*.

AN *Epitome of Herbert Spencer's Philosophy* is in the press, being a condensation in one volume of the ten volumes of Mr. Spencer's series relating to his system of synthetic philosophy. It is compiled by Mr. F. Howard Collins.

AN elegant volume is announced by the publishers of the *St. Moritz Post*, Samaden, Engadine, on the mountains and valleys of the Bernina district, by Mrs. Main and Herr A. Lorria. The work will be illustrated by photographic plates, and the price to subscribers is £4 per copy.

MESSRS. BELL & SONS announce a new "Agricultural Series" at half-a-crown a volume. It will include works on *Farm and Dairy; Practical Fruit Growing; Feeding Stock; Manures and their Uses* (by Dr. A. B. Griffiths, F.R.S.E.); *Soils and their Management;* and *The Diseases of Crops and their Remedies*.

A NEW work by Mr. J. Ellard Gore, F.R.A.S., entitled *The Scenery of the Heavens: a Popular Account of Astronomical Wonders*, is in the press, and will shortly be published by Messrs. Roper and Drowley, of Ludgate Hill. It will be illustrated with photographs of star clusters and nebulæ from the original photographs taken at the Paris Observatory, and by Mr. Roberts, at Liverpool, and drawings from recent sketches by well-known astronomers.

Obituary.

DEATH OF A FAMOUS BOTANIST.—By the death of the Rev. M. J. Berkeley, M.A., F.R.S., F.L.S., vicar of Sibbertoft, North Hants, botanical science has lost one of its brightest lights. He was born in 1803, and received his education at Oundle Grammar School and Rugby, and at Christ's College, Cambridge. Of this college he was a scholar, and in 1825 he graduated as fifth senior optime. At an early period he displayed that natural taste for botany and zoology which was to bear such fruit at a later period. On leaving Cambridge he was ordained, and during the period in which he was engaged with the parochial duties of parishes he devoted much of his time to the study of fungi and their relation to the diseases of plants, especially the potato and vine diseases. In 1857 he published his well-known book, *Introduction to Cryptogamic Fungi*, and in 1860 the *Outlines of British Fungology*. In 1864 the Royal Society awarded him their gold medal for the excellence of his botanical works, and especially his scientific papers in the *Gardeners' Chronicle*. He was examiner in botany on several occasions to the Universities of Cambridge and London. He was elected, in 1836, a Fellow of the Linnæan Society, and also of several foreign societies. The latest honour conferred on him was the honorary Fellowship of Christ's College, Cambridge. He died at Sibbertoft (of which he had been vicar since 1868) on July 30th, 1889.

Letters to the Editor.

Notice to Correspondents

It is important that Letters to the Editor should be as brief as possible and to the point, as it is difficult to find space for lengthy communications.

ACCESS TO OBSERVATORIES.

SIR,—As a student of astronomy, I should like to ask through your columns if it is possible to gain admission to any of our large observatories for the purpose of looking through the telescopes. Considering the number who take an interest in the science but who have only poor instruments at their command, I feel confident that such a favour, if not already extended, would be highly valued.

Padgate, near Warrington,
August 5, 1889.

JOSEPH DAKIN.

MR. W. H. BATH, Ladywood, Birmingham, sends us a specimen of *Data Blanks* useful for filling in particulars of clutches of birds' eggs, and for labelling botanical, conchological, and geological specimens, &c., which, he informs us, are sold by the Naturalists' Publishing Co., 112, Rann Street, Birmingham, price 6d. per 100, or 4/- per 1000, post free. The form provides for the name, locality, collector, and date.

Publications Received.

Chemical and Physical Studies in the Metamorphism of Rocks, by A. Irving, D.Sc., F.G.S. (Longmans, Green & Co.); *Smithsonian Report, 1886*, Part i.; *John Hopkin's University Circulars*, vol. viii., No. 74; *The Tocsin; The Lyceum; The Optical Magic Lantern Journal and Photographic Enlarger; Transactions of the Manchester Geological Society; Brewers' Journal; The Naturalist; Life-Lore; Wesley Naturalist; The Naturalists' Gazette; The Photographer's World; Proceedings of the Association of Public Sanitary Inspectors of Great Britain*, Vol. ii; *Journal and Annual Report of the City of London College Society, 1888-9; Proceedings of the Liverpool Geological Society, 1888-9; Transactions of Manchester Microscopical Society, 1888; Transactions of the Historic Society of Lancashire and Cheshire, 1887; 18th Annual Report of the Chester Society of Natural Science*, &c.

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NOTICES.

☞ In consequence of the extra space required for the report of the British Association Meeting at Newcastle we have been obliged to leave over for this month our usual Biographical Sketch and Portrait, which will appear in our next issue.

Cases for Binding Vol. I., Price 2/-, or by post 2/3, may be obtained on application to Mr. E. O. Windel, 9, Hackin's Hey, Liverpool.

Bound Volumes, Price 5/-, or by post 5/6, can be obtained from Booksellers and News Agents, or from any of the Publishers.

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E. W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & Co. Price 3d., or by post, 4d. Annual Subscription 3s., or by post, 4s.

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Remittances and Communications respecting Advertisements, should be addressed to C. BIRCHALL, 32, Castle Street, Liverpool.

Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the followlng numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

The British Association at Newcastle-upon-Tyne.

ONCE more the annual session of the "Parliament of Science" has concluded its protracted labours, and members have had, for the third time in the history of the British Association, an opportunity of experiencing the warm hospitality of the inhabitants of Newcastle-upon-Tyne. Contrary to expectation, and notwithstanding the elaborate and wide-spread advertisements which the local committee had secured over almost the whole of the north of England, the attendance only reached a total of 2,437, or nearly a thousand below that of the last meeting held at Newcastle, and little more than half of that recorded at Manchester. To whatever cause this falling off may be attributed, it certainly is not due to any want of attractiveness in the locality chosen for this year's meeting. The town of Newcastle-upon-Tyne is the busy centre of many engineering and manufacturing enterprises of the highest scientific interest, and the outskirts, whilst being rich in historical associations, are by no means without those other sources of attraction necessary to secure the highest attention of the geologist or the lover of the many branches of Natural History. Still, although a larger attendance might have been desired, the result is not to be considered altogether unsatisfactory, inasmuch as the number of experts in the various sections reached a figure probably higher than the average at these gatherings.

Reviewing the proceedings of the past meeting, the result at first sight seems disappointing. There has not been a great display of the most conspicuous scientific celebrities of the day; the discussions have been, on the whole, tame and unexciting (with one or two notable exceptions); and no enunciation of a new or startling doctrine has occurred to enliven the monotony of the sectional business. Many visitors expressed a feeling of regret that Professor FLOWER did not select for the subject of his inaugural address a topic of less limited scope than that of Museums—such, for instance, as that to which he devoted an all too brief space towards the close of his discourse. Problems of life and organic development present quite as much scope for rhetorical display as are afforded by the speculations of the physicist and the engineer, so brilliantly brought under review by SIR FREDERICK BRAMWELL at Bath. Professor FLOWER, how-

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ever, on this occasion did not yield to the seductions of the many enticing biological themes upon which he is so competent to dilate, but he placed scientific workers under a debt of gratitude for his eminently practical suggestions in regard to the conduct of those institutions which, whilst capable of furthering so greatly the interests of scientific education, are too often allowed to degenerate into mere storehouses of curious objects. There is little doubt that the President's address will tend to a more enlightened appreciation of the true purposes and functions of the numerous museums scattered throughout the country, many of which hardly fulfil, under existing conditions, the aims and objects for which they have been established, or carry out to its due extent the work for which they have been equipped.

It is not easy to estimate at once the extent to which the advancement of science has been furthered by this meeting. Pessimists may point to the scanty audiences at most of the sections compared with the crowded attendances at the banquets, receptions, and other social gatherings incident to the meeting. But it must not be forgotten that the ranks of the Association are open to many persons of both sexes who, whether as members or associates, exhibit an intelligent interest in the proceedings without wishing to take an active part themselves in the promotion of scientific research. Such social entertainments attract many of those persons who otherwise would not trouble themselves with the advancement of science, to which, it is important to remember, they contribute materially by their subscriptions. The grants for research would inevitably suffer diminishment if dependent solely upon the aid of the comparatively small number of active workers. Thanks to the enthusiasm engendered by the annual meetings, and to the intercourse with men of light and leading from so many distant quarters of the land, the ranks of the active workers are being enlarged each year. Those who reiterate their fears that the British Association is showing signs of decay as a scientific institution, and is in danger of becoming a mere social excursion, should bear in mind that all, or nearly all, of the intellectual giants in the world of science have already said their say, and it cannot be expected that discovery will nowadays proceed so quickly as to produce new and important results at such short intervals. Steady progress is always possible, and so long as this continues to be encouraged in the proper spirit there will be no fear of the British Association failing to fulfil its useful functions.

At the same time, there are one or two features somewhat detrimental to the interests of the Association which have grown, unfortunately, prominent at recent meetings. The practice of reading the same paper in more than one of the sections is much in vogue, and is scarcely to be commended. The tendency to overcrowd the business of sections with programmes of too great a length is growing to be a serious inconvenience. More careful admission of papers would not only facilitate business, but lead to a higher class of papers being retained. Some of the methods of procedure regarding the recommendations of Committees require amendment and simplification, and the rules generally would be improved if revised and brought up to date. These and many other points are well worthy of consideration by the authorities.

Returning to the Newcastle meeting, praise must be accorded to the local committee for the general excellence of the arrangements for the comfort of members and visitors, though here again there was room for improvement, an experience which will doubtless be taken advantage of when the Association meets next year at Leeds. Considerable dissatisfaction arose on the matter of handbooks, which were only presented to members of the General Committee, others being charged six shillings for the set of three. These official publications were elaborately designed, and perhaps even more complete than usual, but a smaller and more compact volume, not too costly to allow of each member being presented with a copy, as has usually been done at former meetings, would have been advantageous. Complaints, too, were rife regarding the high price at which tickets were issued for excursions, and the inadequacy of the commissariat arrangements on some of these occasions. No doubt the Leeds Committee will be guided by these incidents in arranging their plans for next year's meeting, which, there is every reason to believe, will be more than ordinarily successful.

On the whole, if the Newcastle meeting may not be pronounced one of the greatest successes, much has been accomplished in practical and useful work, which can but stimulate and encourage all who devote themselves to the noble task of scientific progress.

PROCEEDINGS OF THE MEETING.

The proceedings commenced on Wednesday, September 11th. The General Committee in their Report referred to the work of the research committees and members to whom grants of money had been made, as ordered at the Bath meeting, and recommended the appointment of the officers for the Newcastle meeting.

At St. George's Hall, in the evening, the retiring president, Sir Frederick Bramwell, vacated the chair, which was taken by the new president, Professor Flower, who delivered the inaugural address. After referring to the claims of the town in connection with scientific discovery, he dealt exhaustively with the subject of museums, tracing their history from the first recorded institution of the kind founded by Ptolemy Suter at Alexandria about 300 B.C., and following their progress throughout mediæval times to the present day. He said:—

There could be no doubt that among the various methods by which the aims of the association might be brought about, the collection and preservation of objects available for examination, study, and reference was one of very great practical importance. The first consideration in establishing a museum, large or small, either in a town, institution, society, or school, is that it should have some definite object or purpose to fulfil; and the next is that means should be forthcoming, not only to establish, but also to maintain the museum in a suitable manner to fulfil that purpose. What a museum really depended upon for its success and usefulness was not its building nor its cases, not even its specimens, but its curator. He and his

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staff were the life and soul of the institution, upon whom its whole value depended, and yet in many of our museums they were the last to be thought of. The care, the preservation, the naming of the specimens, were either left to voluntary effort—excellent often for special collections and for a limited time, but never to be depended on as a permanent arrangement—or a grieviously under-salaried and consequently uneducated official was expected to keep in order, to clean, dust, arrange, name, and display in a manner which would contribute to the advancement of scientific knowledge collections ranging in extent over almost every branch of human learning. Every specimen exhibited should have its definite purpose, and no absolute duplicate should on any account be permitted. Above all, the purpose for which each specimen was exhibited and the main lesson to be derived from it must be distinctly indicated by the labels affixed. A well-arranged educational museum had been defined as a collection of instructive labels, illustrated by well-selected specimens. Very few people have any idea of the multiplicity of specimens required for the purpose of working out many of the simplest problems concerning the life-history of animals or plants. The naturalist has frequently to ransack all the museums, both public and private, of Europe and America in the endeavour to compose a monograph of a single common genus, or even species, that shall include all questions of variation, changes in different seasons, and under different climates and conditions of existence, and the distribution in space and time of all its modifications. A public exhibition which was intended to be instructive and interesting must never be overcrowded, and every specimen should be within full view. The ideal public museums of the future would consequently require far more exhibition space that had hitherto been allowed. Guide books and catalogues were useful adjuncts, but they could never supersede the use of labels. As the actual comparison of specimen with specimen was the basis of zoological and botanical research, and as work done with imperfect materials was necessarily imperfect in itself, it was far the wisest policy to concentrate in a few great central institutions—the number and situation of which must be determined by the population and the resources of the country—all the collections required for original investigations.

The remainder of the address was devoted to a brief dissertation on the nature of the problems of biology and the lines which the endeavour to solve them would probably take.

SECTION A. (*Mathematics and Physics*).

The presidential address in this section was delivered by Capt. W. de Abney, C.B., &c., who dealt with the subject of photography as a stimulus to the study of science. Referring to photography in natural colours, he said that pictures in natural colours had been produced, but the process could never have any commercial value, and that the production of a negative from which prints in natural colours might be produced appears in the present state of our knowledge to be impossible. Supposing it were not impracticable it would be unsatisfactory, as the light with which the picture was impressed would be very different from that in which it would be viewed. The nearest approach at success in producing coloured pictures by light alone was the method of taking three negatives of the same subject through different-coloured glasses complementary to the three-colour sensations, which together give to the eye the sensation of white light.

Lord Rayleigh afterwards addressed the section on pinhole photography, and amongst other papers and reports submitted were those on the viscosity of iron, tidal observations in Canada, the spectra of tubes, seismological work in Japan (by Professor Milne), the magnetisation of iron, the relation of ether to space (Dr. Johnstone Storey), curves (Professor Cayley), electric oscillation (Professor O. J. Lodge), photographs of lightning (Professor Weber), determination of rainfall (Cleveland Abbe), the temperature of water, and the periodicity of mild winters (R. E. W. Goodridge). A joint session with Section C. discussed the relations between the geological constitution and magnetic state of the United Kingdom.

SECTION B. (*Chemistry.*)

Sir Lowthian Bell, F.R.S., in his presidential address to this section, gave an able review of the history of the various working processes in the metallurgy of iron, and touched upon the important results of this industry at the present day. Professor Liveing described a new photographic developer, named "eikonogen." Mr. J. H. J. Dagger read a paper on the manufacture of the alloys of aluminium in the electric furnace; and Professor Clowes called attention to the deposits of barium sulphate in the waters of Durham coal mines, and in Nottingham sandstone. The report of the committee on "Water Analysis" was presented. Dr. Isaac Ashe read a paper on "Dimidium: an attempt to represent the chemical elements by physical forms, with models from hydrogen to nickel constructed in accordance therewith." A new "white-lead" was described by Mr. J. B. Hannay, and Professor Frankland and others related the result of experiments on pure fermentations.

SECTION C. (*Geology.*)

The address in this section was delivered by Professor James Geikie, LL.D., F.R.S., who explained that his aim was to give an outline of some of the results obtained during the last few years by Continental workers in the domain of glacial geology. Starting with a survey of the various hypotheses that have been advanced to account for the drift covered regions of our continent, he summarised the general conclusions arrived at by those who are at present investigating the glacial accumulations of Northern Europe. Many of the papers read in this section were of a purely local character. Those which created the greatest interest were by Dr. A. Geikie on the origin and age of the crystalline schists of Norway, and by the famous explorer, Dr. F. Nansen, on "Greenland." Mr. T. P. Barkas exhibited some very interesting footprints from the Lower Carboniferous of Northumberland. Mr. T. Mellard Reade read a paper on "The Physiography of the Lower Trias." The usual reports of committees were read.

SECTION D. (*Biology.*)

Owing to the unfortunate absence of the president, Dr. Burdon Sanderson, on account of illness, the address was read by Canon Tristram. Dr. Sanderson stated that he had endeavoured to show that at present the fundamental questions in physiology, the problems which most urgently demand solution, are those which relate to the endowments of apparently structureless living matter, and that the problem of the future will be the analysis of these endowments. With this view what we have to do is—first, to select those cases in which the vital process offers itself in its simplest form, and is consequently best understood; and, secondly, to inquire how far in these particular instances we may, taking as our guide the principle as fundamental—viz., the correlation of structure with function, of mechanism with action—proceed in drawing inferences as to the mechanism by which these vital processes are actually carried out. A discussion on "Acquired Characters," opened by Mr. E. Poulton and Mr. F. Galton, and another on "Specific Characters as Useful and Indifferent," created the greatest interest in this section. Professor Romanes read a paper on "Natural Selection not Primarily a Theory of the Origin of Species." Mr. G. C. Bourne described a new and improved form of deep-sea tow net, and gave a report of the work done at the laboratory of the Marine Biological Association. Sir John Lubbock contributed two papers on the "Shape of the Oak Leaf," and "The Guelder Rose." The migration of fishes formed the subject of a valuable communication by Professor J. C. Ewart. Mr. Isaac C. Thompson described some forms of Copepoda new to Britain. A sub-section devoted to botany did much useful work.

SECTION E. (*Geography.*)

Sir Francis de Winton, in his presidential address, reviewed the recent explorations and discoveries of the day, insisting more particularly on the practical value of geographical science in respect of the influence it exerts upon trade and commerce. He described the efforts of Russian explorers in Central Asia, pointing out that by means of a railway carried right into the heart of the continent Russia had obtained the trade of a vast area which formerly passed entirely through British hands, and, having highly commended Dr. Nansen's work in Greenland, he surveyed the explorations made in North and South America and Australia. He briefly summarised what has become known of Mr. Stanley's latest journeys and discoveries. As to Stanley's whereabouts no definite information had been obtained, but, personally, he expressed his opinion that at any moment now news might be received of the great traveller's arrival on the East Coast of Africa.

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He advocated the establishment of a geographical society in every commercial centre in Great Britain.

Among the papers which followed was one on the Congo Railway by Captain Thys, who is attending the meeting on behalf of the King of the Belgians, and who gave a very favourable account of the intelligence and progressive sagacity of the Congo populations. Mr. Sowerbutts, the secretary of the Manchester Geographical Society, urged during the discussion that the tendency of the Free State policy is to force everybody but Belgians out of the region. Other papers of interest were read by Dr. H. R. Mill on the physical basis of commercial geography, several papers bearing on discovery in Africa, and on "Greenland" and the "Eskimo," by Dr. Nansen.

SECTION F. (*Economic Science and Statistics.*)

The president's address was delivered by Professor F. Y. Edgeworth, M.A., F.S.S., who referred to the fact that at the meeting of the British Association which was held in Cambridge about a quarter of a century ago Jevons submitted to this section a "general mathematical theory of political economy," which, as he himself recorded, was "received without a word of interest or belief." The cardinal article of Jevons's theory was that the value in exchange of a commodity measured or corresponded to the utility of the least portion of that commodity. After referring to some questions between employer and employed, and to the abstract principles of political economy, especially the difference between combination and competition, the president said possibly the dry light of abstract science might enable them to see a little further; compared with mathematical physics, however, the mathematical theory of political economy showed many deficiencies.

A discussion on the teaching of Chemistry was jointly entered into with Section B. Professor E. Hull gave an important paper on the state of our coal resources, and Dr. Hoey spoke on the necessity of improved dwellings for the poor. Papers were also read by Mr. Price and Mr. Spence Watson on the "Settlement of Industrial Quarrels;" by Mr. Sidney Webb on the "Theory of Wages;" and on various aspects of technical and scientific education by Sir Benjamin Browne, Dr. Rutherford, and Mr. E. J. Watherston. The Rev. W. Bury referred to the subject of "Poor Law Administration and Reform;" and the Rev. W. Moore Ede, rector of Gateshead, contributed a paper on "National Insurance."

SECTION G. (*Mechanical Science.*)

The address was delivered by the president, Mr. W. Anderson, M.I.C.E., who, alluding to the molecular structure of matter, said:—This branch of science had, up to the present time, been left very much in the hands of the chemist and the physicist, and many engineers might think that it was by no means desirable to change the arrangement; but he was persuaded that the progress of engineering, the more exact methods of dealing with the properties of materials, the increased demands on their powers of endurance, rendered it imperatively necessary that mechanics should interest themselves more deeply in their internal structures and in the true meaning of the laws by which their properties were defined.

Mr. A. C. Humphreys read a paper on "Water-Gas," and Professor Milne contributed an account of an ingenious instrument he had devised for recording the vibration of railway trains. Mr. J. A. London referred to a new process of making paper from fibrous peat. Records of river volumes and flood levels were collected by Mr. C. E. de Rance and brought before the section. Papers were also presented on many practical subjects connected with navigation and water supply, electrical and telephonic communication, and applied electricity.

SECTION H. (*Anthropology*).

The address was delivered by Professor Sir W. Turner, F.R.S., and was mainly devoted to a review of the subject of heredity. The central idea of heredity, said the president, is permanency; that like begets like, or, as Mr. Galton more fitly puts it, that "like *tends* to produce like." But though the offspring conform with their parents in all their main characteristics, yet, as everyone knows, the child is not absolutely like its parents, but possesses its own character, its own individuality. It is easy for anyone to recognise that differences exist amongst men when he compares one individual with another; but it is equally easy for those who make a special study of animals to recognise individual differences in them also. Thus, a pigeon or canary fancier distinguishes without fail the various birds in his flock, and a shepherd knows every sheep under his charge. But the anatomist tells us that these differences are more than superficial—that they also pervade the internal structure of the body. Intimately associated, therefore, with the conception of heredity is that of variability—that is, the appearance in an organism of certain characters which are unlike those possessed by its parents. Heredity, therefore, may be defined as the perpetuation of the like; variability as the production of the unlike.

Some very exciting discussions enlivened the proceedings in this section. Mr. P. B. du Chaillu adduced a new and startling theory that the Vikings were the direct ancestors of the English-speaking people, which was stoutly opposed. The Rev. J. Wilson's hypothesis of a European origin of early Egyptian art fared little better. Canon Isaac Taylor and Professor Boyd Dawkins evidently held widely diverse views on the origin of the Aryans, which Canon Taylor would ascribe to a European rather than an Asiatic source. Governor Moloney created some amusement by his illustrations of the airs and musical instruments of some African tribes, and Mr. W. K. Sibley interested a large audience by his explanation of the habit known as "Left Leggedness." Altogether the proceedings in this section were of a lively and interesting character.

DISCOURSES AND EXCURSIONS.

The evening discourses were very successful and attracted large audiences. Professor W. C. Roberts-Austen lectured on "The Hardening and Tempering of Steel," illustrated by some interesting experiments. Another discourse on "How Plants Maintain Themselves in the Struggle for Existence," by Mr. Walter Gardiner, was regarded as one of the best botanical lectures ever delivered in Newcastle. The usual Saturday evening lecture to the working classes was given by Mr. B. Baker, on "The Forth Bridge." This was by far the most successful of the series, the hall being crowded and the enthusiasm of the audience most marked. Two well-attended *soirées* were given in the magnificent buildings of the Natural History Museum at Barras Bridge, the chief attractions of which were a demonstration by Mr. E. Muybridge on "Animal Locomotion," illustrated by his wonderful apparatus, the "zoopraxiscope;" an exhibition of the Bewick collection of prints, Dr. Collingwood Bruce's drawings of the Roman Wall, and the famous Gibsone's Conches.

The excursions were even more numerous than usual and were of an interesting character, though it was a matter of surprise that in a district of such geological interest, so few excursions, having geology as their chief object, were organised. The following is a list of places visited:—Saturday, Sept. 14th: Morpeth and Mitford, Wallington, Seaton Delavel and Tynemouth, Hexham, Corbridge, Marsden, Prudhoe and Bywell, and Durham. At Durham honorary degrees were conferred by the University on the officers of the Association, with full ceremonial honours. Monday, Sept. 16th: Alnwick, Rothbury, Middlesboro', Berwick, Lanercrost and Naworth, Middleton-in-Teesdale, Beal and Holy Island, Howick and Dunstanburgh, Chillingham, Barnard Castle, and the Roman Wall.

Some other lectures were delive ed in the town in connection (though not officially) with the visit of the British Association. Professor Sylvanus Thompson lectured for the Tyneside Sunday Lecture Society on "The Polarization of Light." Dr. H. H. Lloyd Snape, at the

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Y.M.C.A. hall, gave an address on "The Search for the Elements;" and Mrs. Stopes, at the rooms of the Literary and Philosophical Society, gave a somewhat sensational lecture on "Errors in Women's Dress."

Committee of Corresponding Societies.

This Committee held two meetings. The following is an abstract of the business brought before the Delegates:—

Mr. W. Gray, Belfast, reported that at the request of the Belfast Naturalists' Field Club he had prepared a catalogue of the monuments and settlements of the counties of Antrim and Down, and he had prepared maps on which they were marked in accordance with the recognised code of signals adopted by the International Congress on Archæology a few years ago. Dr. J. Evans said the Society of Antiquaries had undertaken an archæological survey of the entire country, and they intended to publish maps showing all the pre-historic monuments and remains. The survey of the county of Kent had been issued, and other surveys were already in hand. It would prove a most useful addition to the archæological interest of the country. The Rev. E. P. Knubley, Leeds, submitted reports on various subjects, which had been investigated by the Yorkshire Naturalists' Union, and proposed that a recommendation be submitted to the Committee of Section C, that a committee be formed to arrange for a collection of photographs illustrating the geological features of the various counties in the United Kingdom. Touching upon this subsequently, Professor Lebour said that, with regard to geological photographs, there was the greatest possible unanimity in Section C. The matter had been taken up by Professor Geikie, and the Committee of Recommendations had advised a grant of £10, whereas only £5 was applied for, thus showing the cordial manner in which the committee had met the request. The committee to inquire into erratic blocks had made a report on more important boulders, and the position of various boulders had been reported. Rev. E. P. Knubley, M.A., brought before the conference two committees—one for noting the disappearance of native plants, and the other for investigating the invertebrate fauna and cryptogamic flora of the fresh-water rivers of the British Isles. Professor Lebour reported the Committee on Explosives was now in full working order. They had taken up the work of examining the properties of so-called flameless explosives, the main object of which was a philanthropic one. There was another committee, consisting of the Mining Institutes of the North of England, of the Midlands, and of South Wales, which had joined together for the purpose of carrying out a series of experiments with fans. The North of England Institute and the others he had mentioned would be exceedingly glad to receive any hints or information which would tend to the better securing of the objects he had mentioned.

Grants for Scientific Purposes.

The following is a synopsis of grants of money appropriated to scientific purposes by the Committee of Recommendations at the Newcastle meeting, and allowed by the General Committee, amounting to a total of £1,265:—

Mathematics and Physics.—Differential Gravity Meter, £10; Electro-optics, £50; Calculating Mathematical Tables, £25; Seismological Phenomena of Japan, £75; Pellian Equation Tables, £15; Electrical Standards, £50; Electrolysis, £5.

Chemistry.—Properties of Solutions, £10; Analysis of Iron and Steel, £10; Isomeric Naphthalene Derivatives, £15; Silent Discharge of Electricity, £5; Methods of Teaching Chemistry, £10; Absorption Spectra, £30; Recording the Results of Water Analysis, £10; Oxidation of Hydracids in Sunlight, £15.

Geology.—Erratic Blocks, £10; Volcanic Phenomena of Vesuvius, £20; Fossil Phyllopoda, £20; Geological Record, £100; Underground Waters, £5; Excavations at Oldbury Hill, £15; Cretaceous Polyzoa, £10; Geological Photographs, £10; Lias Beds of Northamptonshire, £25.

Biology.—Botanical Station at Peradeniya, £50; Deep Sea Tow-net, £10; Naples Zoological Station, £100; West India Islands, £100; Marine Biological Association, £30.

Economic Science and Statistics.—Monetary Standard, £10; Precious Metals in use as Money, £15.

Mechanical Science.—Waves and Currents in Estuaries, £150; Graphic Methods in Mechanical Science, £15.

Anthropology.—North-Western Tribes of Canada, £100; Effect of Occupations on Physical Development, £20; Anthropological Notes and Queries, £50; Anthropometric Calculations, £10; Nomad Tribes of Asia Minor, £25; Natives of India, £10.

Corresponding Societies, £20.

The meeting next year will open at Leeds on 3rd September, under the presidency of Sir Frederick Abel.

British Association, 1889.

Gleanings from the Sections.

Brain Functions and Human Character.

A PAPER on "Some Observations on the Relations Between Brain Functions and Human Character" was read by Bernard Hollander, of Vienna:—It is only recently that the plurality of the functions of the brain has been demonstrated scientifically; and though a number of English and foreign investigators have succeeded in localising centres for motion and sensation, we are still in need of a method which will enable us to demonstrate centres of ideation or thought. A number of experiments have been made on the cortex of animals, with the result of defining distinct regions for motion and sensation, either by exciting definite portions of brain, and watching the movements that occur, or by destructive lesions and observation of the loss of movements; and though the results in themselves were not, hitherto, considered to be of direct value to the student of mental science, they demonstrate, as will be shown, the physical parallel of certain emotions, and confirm actual localisations made empirically by earlier investigators, whose work, however, has been long ago rejected on account of the insufficiency of their method. A number of facts were collected relating to the subject of brain functions, in their subjective and objective aspects, with the view of showing the possibility of a "scientific" phrenology and the necessity of re-examining the empirical observations made by Dr. Francis Joseph Gall, bearing in mind the defects of his system and the over-strained pretensions of his followers.

The Shape of the Oak Leaf.

Sir John Lubbock, Bart., submitted a paper on "The Shape of the Oak Leaf." He said they were so accustomed to the form of the oak leaf that it did not strike them as anything peculiar, and comparatively few had ever asked themselves why it should be as it was. And yet it was peculiar, unlike that of any of their forest trees, and those of the evergreen oaks so abundant in hotter countries. In botanical phraseology they were "deciduous, oblong-oblanceolate or oblong-elliptical, sinuated, with blunt lobes extending not more than half-way down to the mid-rib. The sinus between the lobes were generally rounded off at the bottom." Again, though he had not found this mentioned in the botanical works which he had consulted, they were rarely symmetrical, the lobes of the two sides not corresponding. The three points, then, which gave the oak leaf its peculiar form were—1. The deep, rounded sinuses. 2. The want of symmetry of the two sides. 3. The oblong or oblanceolate outline. He did not know of any attempt to explain this peculiar form. As regarded the sinuses, Kerner suggested that they were intended to permit the passage of light to the lower leaves. He would not deny that the space between the lobes may be of some advantage in the manner suggested by Kerner, but he doubted whether this was the main or primary explanation. That which he would suggest was as follows:—The leaves of the evergreen oaks were entire and small in comparison with those of the English oak. During the winter and early spring they were protected by a series of brown scales, inside which they lay, and with which thay formed the well-known buds which are so familiar to us, and which are both small and short in proportion to the size of the leaves themselves. In cooler and moister regions, on the contrary, there was, as they knew, a tendency for leaves to become larger and deciduous. He would not now enter into the reasons for this, but the fact would not probably be denied. These influences did not, however, affect the outer scales, which remained as before without any increase of size. But, as the leaves had increased in size and the buds had not, the leaves could no longer retain their original arrangement in the bud. If, for instance, they compared the buds of the oak and of the beech they saw that while the leaf of the oak was longer than that of the beech, the bud of the oak was, on the contrary, shorter than that of the beech. Under these circumstances, what must happen? The leaf grew and became longer than the bud. But an entire leaf if thus thrown into a curve would necessarily fall into folds, the number being determined by the number of ribs or veins. For such folds, however, there would be no room within the narrow limits of a bud, or, rather, perhaps, they would not be inconvenient because they would leave more or less empty spaces. This might be rendered more clear by taking a piece of cloth or paper, folding it up, and then throwing it into a curve. It would then necessarily fall into one or more folds. If it were strengthened, as an oak leaf was, by three or four side ribs, there would be a fold between each two ribs. As a matter of fact, however, from the absence of space the membrane where the fold would be was not actually developed. They might imitate this by removing them. If this were done the result would be the formation of sinuses, rounded at the base, closely resembling those so characteristic of the oak leaf. The young leaf was not only curved—it was wrapped round the interior leaves. The result of this was that one side of the leaf was folded within the other, the one, therefore, being on the outside had more space than the other. The two sides of the leaf were, in fact, differently situated, and this he believed accounted for the second point, namely, the want of symmetry. The paper was illustrated by diagrams, specimens, and models, and the probability of the cause suggested being the true one was enforced by the application of a similar argument explaining the peculiar form assumed by the very interesting and curious leaves of the tulip tree.

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Physiography of the Lower Trias.

Mr. T. Mellard Reade, C.E., F.G.S., F.R.I.B.A., read a paper on this subject. The following is an abstract:—After an introduction describing the various views held by geologists as to the origin of the Triassic rocks of Britain, the author states that circumstances have lately provided an opportunity for a detailed examination by him of considerable areas of the Trias in the North-West of England. As a result of this he has been drawn towards a consideration of the attractive speculations on the origin of these rocks which have emanated from various geologists. Describing the lacustrine theory suggested by the late Mr. Godwin-Austin, and supported by Sir Andrew Ramsay, the author agrees with Professor Bonney that it does not account satisfactorily for the extensive areas of marine current-bedded sandstones constituting the base of the Trias, and known as the Bunter. He considers that the prevalence of pebble-beds in these rocks, as well as the absence of thick beds of marl, is inconsistent with such an origin. Further, referring to the sub-aerial river delta theory brought forward in substitution by Professor Bonney, he contends that, while explaining the deposition of current-bedded sandstones, there is no evidence of the existence at the time of such peculiar physiographical conditions as would be required for the building up of a sub-aerial delta of sand from 1,200 to 2,000 feet thick. Such a delta would require to be fed from a high plateau or from Alpine granitic ranges, of the former existence of which we have no evidence. It is also pointed out that the rivers of Asia and Africa feeding deltaic sands, which the Bunter is compared to, frequently disappear in them by absorption and desiccation leaving saline deposits, while in the Bunter of the North-West of England there is little or no evidence of such conditions having obtained. In suggesting another possible origin for the Bunter sandstones, it is pointed out that the rocks which are preserved appear to lie in the deeper part of the basins in which they were deposited, and that there has been here and there a remarkable preservation of the ancient orographic features, modified, it is true, by folding and faulting. In support of this it is shown that a subsidence of 400 feet would cover most of the Trias by the sea, which would approximately follow in its margin the present Triassic boundaries. Where the Triassic deposits are bounded by the mountains of Wales and by the Pennine Chain or other high land, the overlapping of the present boundaries by the sandstones was limited; but there is every reason to suppose that there was a wide extension of them occupying the site of the Irish Sea. It is contended that these features most probably represent subsided valleys or arms of the sea previously occupied by partly denuded permians, and the author thinks that that tidal action is capable of selecting the materials for and constructing, under conditions pointed out, thick, massive beds of sandstone, current bedded, with intercalated conglomerate beds or with well-rounded quartzite pebbles distributed sparsely throughout the rock, or in nests, as found in all these forms in the Bunter sandstones. Two papers by the author on tidal action as a geological agent, in the *Philosophical Magazine* and the *Proceedings of the Liverpool Geological Society*, were referred to in explanation of the physical questions involved. It is suggested that a granite area, such as would be exposed now by an elevation of, say, 1,000 feet, occupying the site of the English Channel, together with the old red sandstone beds of the anticlinal axis connecting the Mendips with the Belgian coal field, reinforced by the sand derived from the immense destruction of carboniferous sandstone which we know has taken place in the Pennine Chain and in other areas, together with the denudation of the Old Red of Hereford, may have supplied the materials for the Triassic rocks, which were distributed and built up by tidal action in straits, seas, and bays. It is also suggested that the quartz boulders and pebbles have most probably travelled from the south, as they are less in number and smaller in Lancashire than in the conglomerate of Market Drayton. To the objection that no marine fossils are present in the Bunter sandstone, the author, while allowing a considerable amount of force to the circumstance, points out that it is only negative evidence, proverbially unsafe, and sets against it the absence of saline deposits, which we would expect on the sub-aerial delta theory. Finally, it is shown that the distribution of the lower Triassic sandstones is inconsistent with a fluviatile origin.

Dr. Nansen on Greenland.

Dr. Nansen read a paper on Greenland. In the course of his remarks he said the scientific results of the expedition could not at present be stated, many observations not having been worked out by the respective *savants* to whom they had been submitted. There were, however, some points which, especially in geological and meterological senses, were prominent. Many geologists had suggested that the interior of Greenland was ice and snow-clad, but there were others who were of opinion it was not snow-clad. Amongst the latter he would mention the famous Nordenskiold. The new expedition had settled the fact that part of Greenland was not only ice-clad and snow-clad, but had a mighty shield-shaped covering of snow and ice, under which mountains as well as valleys had quite disappeared, and where they could not even trace the configuration of the land and mountains. Whether this was also the case in the most northern parts of Greenland he dared not yet say. This must be decided in a new expedition, and he thought the question to be one of the highest interest. At present they had only to consider the southern parts of Greenland. The ice-covering had the shape of a shield. Rather rapidly, but regularly, it rose from the east coast, reached a height of 1,000 to 10,000 feet, was rather flat and even in the middle, and fell again regularly towards the west coast. What had occasioned the regular shape? What was the configuration of the land beneath? In the interior of Greenland there must be mountains and valleys as well as near the coast. That there were on the coast deep fjords and lofty mountains, very like those of Western Norway, and that they had just the same wild and prominent character in some places they already knew: they were perhaps even wilder than ever he saw them in his own country. If they entertained the opinion that those fjords were excavated by the ice, they must also conclude that the same ice had been able to excavate valleys, and form mountains in the interior of the continent. He thought, therefore, they had no right to seek the reason of the shield-like shape of the ice in the configuration of the land underneath. The surface of the ice must have a shape of its own, which was given, not by the land, but by the meteorological circumstances. Nobody could deny that the ice must in some places have a quite enormous thickness, as it filled the valleys and covered up all the mountains, and its thickness must evidently be regulated by the quantity of snow falling. This quality must be largest towards the coast, gradually diminishing towards the interior. It was consequently very likely that the ice had not its greatest thickness just in the middle of the continent, but rather on both sides towards the coast. They might thus already *a priori* have expected to find a shape of the ice just like that observed.

Methods of Teaching Chemistry.

The report of the committee on "Methods of Teaching Chemistry" was read, but it will be sufficient to give here the final conclusions, which are that very exaggerated notions exist, and are becoming more and more prevalent, as to what may be properly attempted so far as the teaching of chemistry in elementary schools is concerned. The public do not realise that in the countries where science is most cherished and applied most extensively and successfully to industry (*e.g.*, Germany and Switzerland), the chemical and scientific teaching in the elementary schools is of the most simple and general character, and that the systematic teaching of science for technical purposes begins only in higher schools, polytechnics, and universities. The systematic teaching depends for its success no more on the previous training in science than on the previous training in arithmetic. It demands solely that the previous training shall not have given merely information, but that it shall have developed intelligence, that it shall have been rational and thorough, and have been administered by good teachers. In this country too much or too little is being attempted, and it is quite a common thing to find boys possessing a large amount of detailed "information" about chemistry, and a certain mechanical aptitude in chemical analysis, who are unable to do a sum in simple proportion, or to write their own language correctly. The most that can be properly aimed at in teaching chemistry in elementary schools is the training of the faculties of observation and of orderly thinking, and the stimulation of the instinct of inquiry, which is the possession of every "uneducated" child. By restricting the teaching to common things and occurrences this can easily be done, and so an interest be aroused both in the phenomena of nature and in those involved in industrial operations. In this way there will be created an interest in and appreciation of chemistry amongst the many, and preparation made for the few who can proceed to the highest study of the subject, which alone is directly applicable to the advancement of industry.

(Further "Gleanings" will appear in our next).

Afterglows.

By Dr. McPherson, F.R.S.E.

(Extension Lecturer on Meteorology in the University of St. Andrews.)

AUTUMN sunsets have never failed to attract the attention of even the careless observer. There is a wonderful compensating power in nature. The mind saddens after the brilliant summer is over; the rich grandeur of the foliage and sward is gone; gone, too, is the balmy air from the western horizon. But while the last cartload of the year's fruits is being taken into the stack-yard, the sower is scattering the wheat-seed into the genial bosom of the soil for another year's production. Here we have life out of death—beauty out of decay.

But the most gladsome compensation to us at this depressing season is the glorious sunset. The varied colours of the copse, from the yellow laburnum to the bronzed oak leaves, produce a splendid effect: but the heavens in sunset entrance us and dispel all gloom. A magnificent array of clouds of numberless shapes occupy the rosy air. Some are of silvery purity, with rich gold fringes, others are embroidered with burning crimson, and their resistless charm keep us spell-bound.

For several autumn seasons we were privileged with extraordinary sunsets. Now these are less frequent and less brilliant; but still we

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have an occasionally gorgeous transformation-scene presented to our view. No two sunsets are alike, and the picture is never the same for two successive seconds. This variety rivets the attention of the observer, especially in sunsets over the mountains. The flood of rosy light, deepened into bright crimson, brings out into bold relief the sharp peaks of the everlasting hills, as if a mighty fire were consuming the world beyond. The foliage is clothed with a golden sheen, the dwellings of man are bronzed with rich colouring, and a gorgeous transformation-scene charms our excited fancy. What is the cause of all this colouring?

All observers have remarked the immense wealth of the various shades and tints of red. This is due to the presence of dust-particles in the air. These particles stop the direct course of the sun's rays and reflect them in all directions; but they chiefly reflect the rays of the violet end of the spectrum, while the red rays pass on almost unchecked. Overhead is the display of the blue-reflected colours. Gradually, as the eye descends from the deep blue zenith, it observes the softening of the blue into green, the wonderful greenness sometimes seen in a clear space in the sky being occasionally intensified by contrast with the rose-coloured clouds which envelope it. There we behold "islands all lovely in an emerald sea." Such effects are produced by the dust in the air sifting out and assorting the colours.

But the afterglows puzzle us more. After the sun has sunk below the horizon, the light seems to return for a time with increased brilliancy, "trailing clouds of glory" in its gorgeously capari-oned train. Over the hills a flush of orange hovers, softening up into harmonious union with the blue that reaches down from the zenith. Suddenly the light fades, and piles of cold, pale cloud rise above: and the hill tops, once ablaze with gold light, are now chillingly dark. But quick as lightning the roseate flush of beauty rises in the face of heaven, as if love-possessed under nature's canopy. A flood of glory rolls and moves along the summits of the mountains, and a rich but softening afterglow colours the heavens.

Mr. John Aitken, of Falkirk, has devoted much attention to these afterglows all over the world, and his explanation of the phenomena is now generally accepted. The colours of the afterglow are quite different from those near the horizon. In the latter case they vary from yellow through orange to red; but in the upper glow a very different red is seen. After the sun has set, a peculiar reddish glow appears high up in the western sky from about 15° to 40° above the horizon. Gradually the upper peculiar red descends and merges into the lower colours, melting into new tints. In the eastern horizon the clouds blush with a rich roseate tint, as if the sun were rising through thick mists in early morn. This colouring rises, tinging the margins of the clouds until the whole sky is illumined with a peculiar reddish light. Strange is it that the colouring reaches its maximum in the east. This fact puzzled most observers till Mr. Aitken removed the veil. Sometimes a second glow appears. Half-an-hour after the first glow has merged into the horizon colours, and the heavens have all but taken on their leaden neutral tint, a second charms the observer for a moment. This soon dies away. The sky takes up its usual night appearance, and the peaceful sway of colourless twilight is begun.

The first upper glow is supposed to be produced by the direct rays of the sun illuminating the dust-particles floating in the atmosphere in their countless millions; for in even ordinarily pure air Mr. Aitken has, by a marvellous apparatus, been able to count millions in a cubic inch. But the brilliant western horizon light is the source of illumination of the second glow.

Water-vapour, by absorbing the rays of the blue end of the spectrum, is largely instrumental in deepening the red colours and intensifying the effect of the dust-particles. The dust causes a more perfect sifting action on the sun's rays in the outer strata of the atmosphere, and provides a greater number of particles in the lower strata large enough to reflect the red rays. If the upper strata of air were destitute of dust-particles, the effect of the sunset would be very much paler. If there were no large particles in the lower strata, a leaden grey would take the place of the gorgeous sunset colours. In fact, it has now been concluded by the most eminent physicists that, if our atmosphere were perfectly void of dust-particles, the light would simply pass through without being seen; and, soon after the sun has sunk below the horizon, total darkness would envelope the earth in its gloomy mantle. The length of our twilight, therefore, depends on the amount of dust in some form or other in our atmosphere. The dust-particles form a free surface for the condensation of the water-vapour. As the sun sinks, but before it ceases to illumine the clouds, the temperature of the air begins to fall, and this cooling is accompanied by an increase in the size of the particles floating in it, by this condensation of the water vapour. A very fine mist has taken the place of the dry dust. The particles to the east first lose the warmth from the sun's rays; the temperature is there first lowered; the dust-particles as free-surfaces attract the water-vapour by reason of the lowering of the temperature, and fine mist-particles are formed. These larger water-clad particles of dust sift the rays and produce the red colouring. Shortly afterwards the particles overhead become cooler and attract the water-vapour; thus they, too, increase in size, and reflect the red rays from the sun. Hence the red hues, at first visible in the east, slowly rise, pass overhead, and descend in the west to form the aurora afterglow. This effect Mr. Aitken has accurately observed by means of the polariscope; but a very careful observer can trace the successive colourings from the east overhead and on to the west with the naked eye. The polariscope, however, can cut out the polarised light and indicate before the first afterglow commenced whether it would be bright or not; it can also reveal beautiful red afterglows, even when invisible to the unassisted eye.

There is no doubt that the air is impregnated with fine volcanic dust. We have several specimens taken by a friend from the deck of a sailing vessel at different places between the Cape of Good Hope and Australia. These are composed of small glassy crystals. An abundance of these would quite account for the peculiarity in the appearance of the first afterglow. The clouds (which are just an aggregate of dust-particles clothed with water vapour), fine dust, and these crystalline particles (from some volcanic eruption), when brightly illuminated in the west, in turn become a source of illumination and reflect the reddish light, lightening up particles suspended everywhere in the atmosphere. When the autumn evening becomes intensely chilly, the water-clad dust particles get frozen, and the red light streams with rare brilliancy, causing all coloured objects to glow with a weird and awe-inspiring brightness. The bronzed beech leaves, for example, which under ordinary conditions of light are not conspicuous, brightly shine with a strange hue. All the red-tiled roofs and red sandstone gables of the houses are brilliantly illuminated with vermillion hues.

The afterglow, then, is only the *reflection* of the sunset colours on the horizon by the same particles which shone by *direct* sunlight in the setting. It is always possible to tell whether the afterglow will be brilliant or not, before it makes its appearance. For, if the horizon colours are high up and brilliant, a grand afterglow is sure to follow; whereas, if these are low and dark, no afterglow is observable by the naked eye.

It has been said that the colouring in the afterglow is not the same as the sunset colours of the horizon, but is of a crimson hue. Now, according to Mr. Aitken's theory, this is just what might be reasonably expected. For, from the lower strata, in which the large crystalline particles are, red light is reflected to us; but from the higher strata a certain amount of blue light is also reflected, and these two sets of reflected rays—red and blue—combining in certain proportions, give the varied crimson tones. When a second afterglow appears, the red on the horizon is combined with the green and the yellow, which still

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hover almost invisibly to us, and more or less orange appears for the moment.

The study of this glorious phenomenon of afterglow—especially brilliant in autumn—tells us that dust-particles in the air are absolutely necessary for the thought-inspiring twilight; that the greater the number of these particles, the more the western sky is illumined at sunset, the more brilliant are the sunset colours and the more extended is the twilight; that the afterglow is caused by transmitted light being reflected to the earth by small dust-crystals floating in the air, and heightened by the variations of temperature in the increase of the size of the particles by condensation of the water-vapour; and that long after the sun has sunk below the green and orange horizon these suspended particles make the heavens gorgeously blush with reflected glory. Passing strange is it that the grandeur of the heavens in sunset afterglows depends for its existence on dust-particles and water-vapour! How simple are the elements of beauty in Nature when carefully analysed! Her field is limitless for industrious *research*, and her rewards are ever gratifying to the earnest student.

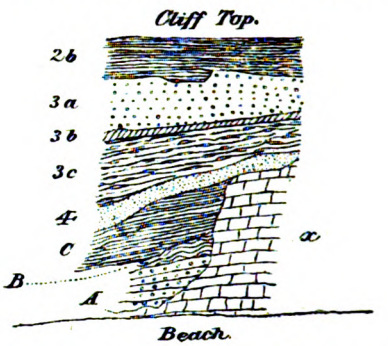
Scientific Aspects of Health Resorts.

VI.—Bridlington and District.

BRIDLINGTON, like Scarborough, has its countless admirers and visitors, who never seem weary of traversing its fine, broad sands, or renewing health in pleasurable boating upon the usually placid waters of the bay. Without the steep ascents which are found in Scarborough and Filey, it forms for the jaded man of business or the over-strained scientist a real haven of rest, where his energies may be recuperated for more work and additional research. As Scarborough is to the geologist a capital centre for investigation of the Oolites, so Bridlington presents equal facilities for a closer knowledge of the Cretaceous rocks. Many splendid excursions may be made during a stay at this pleasant watering place by the zealous hammerman with a certainty of obtaining rich experience. From the stone pier of Bridlington a fine view may be obtained; on the right the low receding shores of Holderness, whilst on the left the prospect is more inviting, the cliffs of Boulder Clay give place to those of Chalk, culminating at length in the bold promontory of Flamborough Head. The Boulder Clays of this immediate district have been made famous by the unremitting labours of Mr. G. W. Lamplugh, and, in fact, his numerous and valuable papers upon the deposits above-named are so accurate and practical that no modern work upon geology is complete without references to and extracts from them. And, if ever favoured by the company of that accomplished geologist, as the writer has been, it would be pointed out that the beds in the cliffs at hand have been divided into four divisions, the uppermost being at present correlated with the Hessle Clay, then the Upper and Lower Purple Clays (reminding us of our visit to Filey), and the Basement Clay. The last-named division is one of especial interest to geologists, and has been a fruitful theme for speculation for nearly seventy years. In this clay occur those masses of sand and clay so full of foraminifera, mollusca, &c., that a mere enumeration of them occupies nearly five pages of the *Geological Survey Memoir*. These remarkable deposits are really gigantic masses probably torn up from the bed of the German Ocean by ice and thrust into the clay.

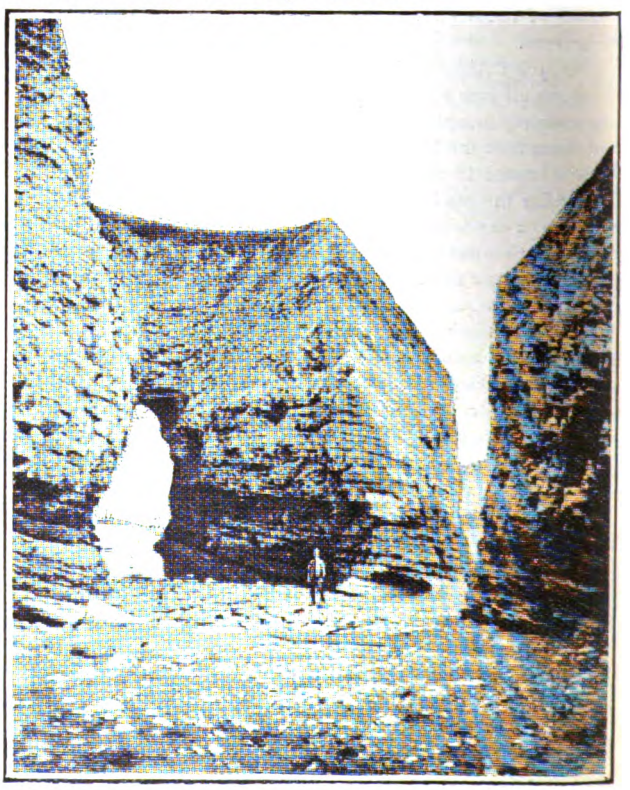
In our walk towards Flamborough we may also note an excavation which has been made in the side of the cliff. This was undertaken by the Yorkshire Geological Society, under the auspices of the British Association, who conferred a small grant for that purpose. Messrs. Lamplugh and Boynton "first cut a trench from the shore line into the cliff at right angles, so as to show as complete a section as possible, and then excavated, for the space of about 40 feet, the deposits and talus which were banked against a buried cliff of chalk, revealing a very clear and instructive section." During the course of this work a very large number of bones, teeth, and other remains were unearthed. The section

SECTION OF CLIFF AT SEWERBY, AFTER LAMPLUGH.



Top soil. 2*b*. Well-bedded chalk gravel (the Sewerby gravel). 3*a*. Brown boulder clay. 3*b*. Stratified seam of silt and gravel. 3*c*. Dark boulder clay. 4. Rough chalk rubble. C. Clean blown sand. B. Clayey chalk wash, an old land surface. A. Old sea beach of rolled chalk pebbles. *x*. Ancient cliff of chalk.

showed, viz.:—Top soil, 2 to 3 feet; well-bedded chalk gravel (the Sewerby gravel), about 12 feet; brown boulder clay, 15 feet; stratified seam of sill and gravel, 1 to 2 feet; dark boulder clay, 12 feet; rough chalk rubble, 1 to 2 feet; clean blown sand, about 25 feet; clayey chalk-wash (an old land surface), 5 feet; old sea beach of rolled chalk pebbles, 5 feet; ancient chalk cliff, 35 feet. This is evidence that previous to the great ice age the sea covered Holderness, the line of coast being then in the direction of Burton Agnes and Hessle, and now the sea is again slowly but relentlessly and surely attacking the shores of Holderness, and absorbing and overwhelming them, so that in the course of time all these glacial deposits will be carried away, and the Wolds will look out once more upon the ocean.



SELWICK'S BAY.
(From a photograph by J. W. Shores, Bridlington Quay).

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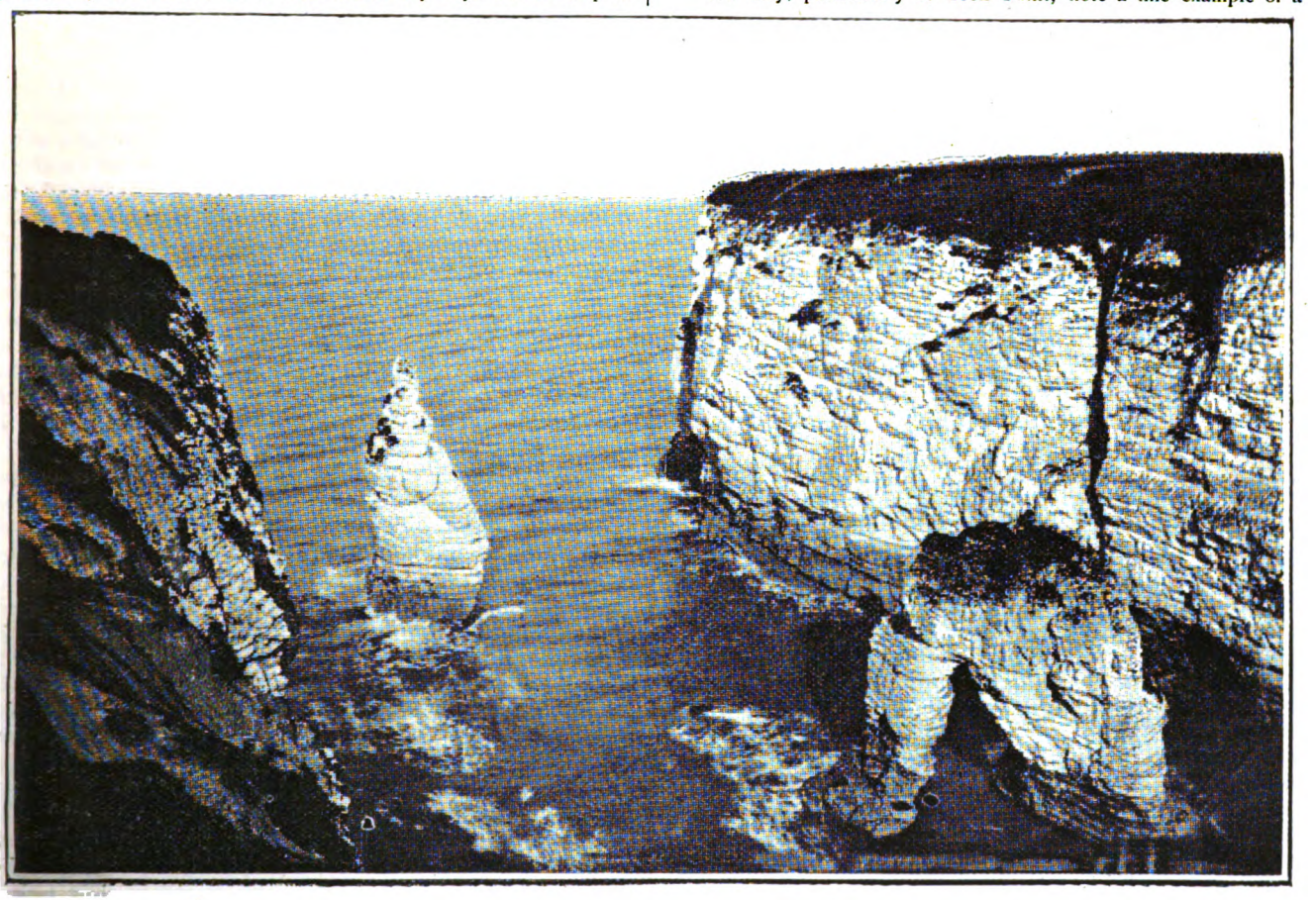
As we proceed, we pass Dane's Dyke, where the small stream has partially re-excavated the old valley filled up during the glacial period. If permission is duly obtained from the lady who lives in the handsome residence on the top of the hill (Mrs. Dormer), a walk up the bed of the stream would repay the exertion. In a few hours during an excursion a short time ago, the characteristic shells (*Cyprina islandica* and *Tellina balthica*) were obtained amongst others from the boulder clay, whilst from the chalk over 40 different species of fossils rewarded the efforts of the collector; a fine collection of travelled rocks from the boulder clay was also made. We must ascend the cliff at the south landing, and, like everyone else, visit the lighthouse, which every evening flashes its well-known light far over the ocean.

We are now about a quarter of a mile from the edge of that bold promontory so familiar to us from school-boy days on the map as Flamborough Head, and as we stand on its verge we must be impressed by the wide extent and superb character of the prospect before us. The geologist, too, will have noticed that, as we have approached the Head, flints (which in the Upper Chalk of Yorkshire are absent) have now begun to appear, both nodular and tabular in their character, and in some places those gigantic flints, which have received the name of paramoudra, may be seen. There is much to study in the chalk formation; for instance: what is the reason of that peculiar needle-shaped structure we see in many places, and which has occasioned so much discussion? The banded flints, too, will not escape notice and enquiry. As we pass on to that beautiful little bay known as Selwick's (not Silex, as it is erroneously named), we may note a curious matter, namely, a mass of Speeton clay, with its characteristic fossils, thrust or drifted on the chalk. There is also a fault here, which is really the cause of the bay being formed, as the bent and broken strata at this place have not been able to resist so well the unceasing attacks of the sea. As we keep on our way at the edge of the cliff we have splendid opportunities of observing the powerful and also beautiful effects produced by the erosion of the waves. There are caves and arches, and miniature bays, and here and there lonely pillars and pinnacles, like the King and Queen Rocks, and others. These isolated masses show well the effects of the erosion alluded to; once supports of gigantic caves, of which the roofs have long ago fallen in, they stand like melancholy sentinels against the thunder of the waves, and will ultimately disappear.

We may, particularly at Breil Point, note a fine example of a "blow hole," similar to that at Kynance Cove, where the water is violently ejected by the force of the compressed air, and flies in fine spray at right angles to the rock. This is another form of erosion; these "blow holes" will eventually enlarge into caves, and so the work of destruction goes on. No visit to Flamborough is complete without a boat being taken from the North Landing to inspect some of the caves alluded to, as Robin Lyth's Hole, and others. It is impossible to thoroughly grasp the effects of erosion here without actually sailing into and examining the caves themselves. As we continue our northward walk we have to cross that remarkable earthwork known as the "Dane's Dyke," and the geologist may well pause to inspect it and muse upon its origin. This great defensive work runs north and south, a distance



KING AND QUEEN ROCKS, FLAMBORO' HEAD.
(From a Photograph by Valentine & Sons, Dundee).

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of two and a half miles from cliff to cliff, and is of nearly uniform height all along, being about 18 feet above the level of the ground, and having a ditch 60 feet wide on the outside. Although the name "Dane's Dyke" is used in speaking of it, yet systematic excavations carried on by competent archæologists have revealed weapons, &c., of a higher antiquity than the Danish invasions of England. When the writer stood a few years ago on the summit of this mighty rampart, he could not help but meditate upon the scenes enacted here, and think who were the fierce assailants who rushed up its slopes in deadly combat with its defenders. History is silent and tradition is obscure, but certainly in those far-off days many sanguinary battles were fought in this now lonely corner of Yorkshire. If we continue our beating expedition from the caves until we come under the tremendous cliffs of Bempton and Speeton (known as the White Cliffs, and here some 450 feet high), we shall note some extraordinary contortions in the chalk. These have attracted considerable attention from geologists, and certainly should be inspected. The boulder clay, which at Flamborough Head covered the chalk very thickly, is here much thinner. The naturalist will also be delighted at the myriads of sea birds which make their homes in these inaccessible cliffs. Pursuing our journey, we come to one of the most interesting geological spots in the whole country, where the white chalk, which at its base has pink and white bands, is succeeded by the red chalk, or equivalent of the Hunstanton limestone. Its characteristic fossil, *Belemnites minimus*, is very abundant. We are also at this place on the far-famed Speeton clay, to which great numbers of enthusiastic geologists have been attracted for many years, and great has been the joy when a fine *Meyeria ornata* or an *Ancyloceras* has rewarded patient search. For details of these remarkable beds the reader must be referred to the works of Judd and Lamplugh. Here on this splendid geological ground we will leave the worker, convinced he will most reluctantly depart from this favourite spot.

RUDSTONE CHURCH AND MONOLITH.
(From a Photograph by W. Fisher, Filey).

Of course the chief attraction of Bridlington and district is its line of cliffs, with the varied and classic sections there revealed, but still one inland journey may be made with profit, namely, to see the celebrated monolith of gritstone known as the "Rudstone," in the churchyard of that name. It is some 45 or 50 feet long, in breadth 5 feet 10 inches, and in thickness 2 feet 3 inches, and its estimated weight about 46 tons. Half of it is buried in the ground. There is a capital article in the *Naturalist*, March, 1888, from the pen of the Rev. Maule Cole, M.A., upon the "Rudstone," dealing among other matters with the probable derivation of the word, which will well repay perusal.

For further details upon this district the reader is referred to the following Memoirs of the Geological Survey, viz.:—*The Geology of Bridlington Bay* (1/-), by J. R. Dakyns, M.A., and C. Fox Strangways, F.G.S.; *The Geology of Holderness* (4/-), by Clement Reid, F.G.S.; and *The Geology of the Cretaceous Rocks South of Scarborough*, by C. Fox Strangways, F.G.S., already mentioned. The Rev. E. Maule Cole's *Popular Handbook* (1/-), or *Geological Rambles in Yorkshire*, will also prove an entertaining and profitable companion. The 1-inch Geological Survey maps are quarter sheets 94 N.E., 95 S.W., and 95 S.E.

S. A. A.

The Influence of Forests upon Climate.

At the last meeting of the Agricultural Society of Sweden Dr. H. E. Hamberg, of the Central Meteorological Institute of Stockholm, and well known for his researches upon the subject, gave an account of the results of the investigations respecting the influence of forests upon the climate which have been carried out in Sweden, and which are of peculiar interest and importance by tending to disprove entirely the theories generally held upon the point by students of forest culture.

The researches were commenced at the instance of the Crown in 1876, when experimental stations were opened in certain forests and upon open land, whilst soon after some were also established on clearings in the forests. Besides ten stations thus established by the Crown, six more were opened in the Province of Upsala by the Agricultural Society of that Province, all in the hands of Dr. Hamberg. Thanks to the liberality of the Husbandry Society of Sweden, there are now 430 such stations in that country.

Dr Hamberg, having explained this, exhibited a series of tables based upon six years' observations, and showing the various temperatures on free land, on clearings in the forests as well as under trees, at the same time urging the importance of the thermometers used in similar observations being removed from all disturbing influences, and that, with a view to comparisons of different localities, the local surroundings of the thermometers should be as similar as possible.

From the tables thus framed it appeared that underneath trees the temperature during the warm season is lower in the morning and at noon than in the open; whilst, on the other hand, the temperature underneath trees is all the year round somewhat higher in the evening, and in winter also in the morning. Again: the difference between the temperature in the open and on clearings in the forests morning and noon is very small. However, especially in summer and autumn, it is colder on the clearings evening and night than on free land. Further: variations of temperature are greater on the clearings than on free land.

Referring to the common assertion of the forests affecting the climate so as to make it more marine, that assertion was to some extent true if the temperature underneath trees be compared with the temperature on free land; but this was not the case with the clearings, where the variations of temperature were greater than on free land. Therefore, he had come to the conclusion that in respect of temperature forests did rather harm, inasmuch as they deprived the earth of the sun's heat and lowered the temperature on the ground on clear nights, whereby frost was fostered. On the other hand, he had found that the forest affords shelter against cold and cutting winds.

Dr. Hamberg next proceeded to refer to the moisture of the air in various countries, and the influence of forests upon the same. It was found that in cloudy weather there is hardly any difference of temperature on clearings and in the open at whatever season or time of day. In clear weather, on the other hand, the air is more moist underneath trees than on the clearings, but less still on free land. On the whole, the researches in Sweden went to show that forests do not influence the humidity of the air. For instance in the island of Gothland the new forests had not increased the rainfall in the least, but they were excellent in protecting from cold and cutting winds. There appears, however, to be one exception, viz., in the Province of Halland, in the south-west of Sweden, where the rainfall was considerably greater in the forest land than in the open, although both localities were close to each other. It

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should, however, be pointed out that the observations of the rainfall had as yet not been completely analysed. Dr. Hamberg concluded by maintaining that the climate of Sweden rested on a more solid basis than the forests, and that there were more weighty reasons to preserve the forests than the climate, upon which research had shown they had very little influence.

An interesting discussion ensued, in which Herr Styffe, an arboriculturist, maintained that, although the forests might not influence directly the moisture of the air and the temperature, they reduced the violence of the wind, which, if dry, also dried the earth. Moreover, water flowed far quicker to the rivers in forestless regions. He considered that forests had a great influence upon the vegetation. On the other hand, Baron von Krœmer shared the views of Dr. Hamberg, believing that the influence of forests upon the climate was rather imaginary than real, the Swedish saying of "the forests being the poor man's comforter" being explained by the shelter which it afforded against cold and cutting winds, but not by its being warmer in it. Moreover, this protection was not always desirable, as was shown in Scania, where the corn dried much quicker after rain on free land than when it was girded by forests. Sjunberg, another student of forestry, considered the results of Dr. Hamberg's researches very discouraging to forest culture, believing, however, that forests retained the moisture of the air, and that their clearing caused increased floods by the heavier downpour. Other speakers, among whom were Count Lagerbjelke and Baron Fork, maintained that the forests were of considerable influence upon the climate, in spite of the result of Dr. Hamberg's researches.

Notes in Brief.

THE Royal Botanic Society has celebrated its 50th birthday. The jubilee year has been the most successful ever enjoyed by the Gardens, the collections, income, and number of visitors having increased to a large extent. Valuable additions have been made to the collections of medicinal, economic, and rare plants, which have been re-arranged. Twenty-five years ago the number of persons studying in the Gardens was 163; now the students number 744. During the year 42,000 specimens of plants and flowers have been distributed for study in hospitals, colleges, and schools.

EFFORTS are now being made to bring that invaluable publication, the *Geological Record*, up to date. Mr. William Topley and Mr. C. Davies Sherborn, are undertaking the joint editorship, and it is greatly to be desired that all interested in the study of geology should aid this work by becoming subscribers, and by forwarding to the Editors (28, Jermyn Street, London) copies of their memoirs, papers, or other works to be included in the *Record*. Although the work done is mainly gratuitous, the support received is not sufficient to pay expenses, even with the aid of the British Association grants. As an inducement to subscribers, complete sets of the *Record* are now offered for £2 10s. (8 vols., 1874-84). The volume for 1880-84 is now published; two volumes for the years 1885-1888, and one volume for 1889 are in active progress.

AN important work on the Middle Lias of Northamptonshire has been brought out by Mr. Beeby Thompson, F.G.S. Chapters are added on the stratigraphical and palæontological relation of the beds, and the Lias is also considered "as a source of water-supply" and "as a mitigator of floods."

AT present 314 Russian students are studying at German universities, viz., 112 in Berlin, 44 in Leipzic, 23 in Heidelberg, 17 in Munich, 13 in Königsberg, and 11 in Strasburg. Of these 101 study medicine, and 54 natural sciences.

SOME very curious facts were laid before a meeting of the Paris Academy of Medicine, which seem to show that in some instances hypnosis may take the place of chloroform. A young woman of twenty-five years of age, a patient in the Hôtel Dieu, passed at a glance of the hypnotiser into the hypnotic condition, then followed him to the amphitheatre and submitted to a difficult and dangerous operation, which occupied twenty minutes, and was witnessed by forty persons, without giving any sign of pain, or having the least consciousness of what was happening. So complete, indeed, was her insensibility that when she was told that the operation had been performed she denied it. As, however, comparatively few can be hypnotised to this extent, chloroform is not likely to be superseded in the vast majority of cases.

A "RESIDENTIAL TECHNICAL SCHOOL" for gentlemen's sons is now established at Folkestone, under the management of Sir Edmund Hay Currie. The courses of study include special facilities for engineering, land surveying, agriculture, chemistry, geology, electric lighting and power, physics, and mathematics. Technical high schools are now widely established abroad and on the Continent, but there has hitherto been in this country a want of superior technical training adapted for the large numbers of young men of gentle birth who have undergone a course in general and classical subjects without reference to their future individual careers, which, in an increasingly large number of cases, now tends towards occupations in which strict technical and scientific training is necessary. The first term of the new school opened on the 10th September.

A MEMORIAL tablet has lately been erected on the old farmhouse at Tucking Mill, Somerset, where William Smith, the geologist, lived for many years. The inscription on the tablet is as follows:—

Here lived
WILLIAM SMITH,
"Father of English Geology."
Born 23rd March, 1769. Died 28th August, 1839.

MORE recognition of genius! We learn that a granite tablet has been fixed upon the house in Cross-street, Redruth, Cornwall, which was at one time occupied by William Murdoch, the founder of the gas industry. It bears the following inscription:—

WILLIAM MURDOCH
lived in this house
1782-1798.
Made the first locomotive here, and tested it in 1784.
Invented Gaslighting and used it in this house, 1792.

A CORRESPONDENT writes that there are many fine specimens of minerals exhibited at the Paris Exhibition, and the illustrations of ores are exceedingly instructive. In many cases, however, the idea seems to be that, in order for people to understand the labels attached to the mineral specimens, it is necessary to cover up all the writing on them by the stones which are described thereon.

WALES is rapidly becoming the El Dorado of mining speculators. Within the last few weeks important discoveries of gold quartz are said to have been made in the Moel Famman range of mountains in Flintshire, where what is described as a "valuable lode" has been struck on the north side of the mountain.

IN North America the jasper industry has been largely developed. The Sioux Fall streets are paved with it, and four-storey buildings constructed with jasper, which, when polished, looks much like the red granite of Missouri. Geologically there is some uncertainty about this so-called jasper, which is regarded by some experts as a red quartzite. Professor Winchell states that it is the hardest stone in the United States that has been used for building purposes.

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ONE of the largest "cat's-eyes" ever found has lately been discovered in Ceylon. It weighs 6 lbs. and 6 rupees. The value of this mammoth gem is said to be £19,000.

CORNWALL can now boast the possession of what is believed to be the only known lode of uranium in the world. Up to the present time this rare metal has only been met with in isolated "pockets" and patches in Cornwall, Saxony, and Bohemia; but the lode just discovered at the Union Mine, Grampound Road, is a true "fissure lode," and the ore has been found to contain an average of 12 per cent. of the pure metal. The lode traverses the mine from north to south and the uranium occurs in it chiefly as a sesqui-oxide, the most important of the several oxides of the metal.

AMONGST the industrial uses of uranium, the protoxide of this metal is employed in producing the costly black porcelain, while the sesqui-oxide is used for imparting delicate golden and greenish-yellow tints to glass. As a substitute for chloride of gold it is also applied to photographic uses. It is anticipated that the present discovery will facilitate the substitution of uranium for gold in electro-plated ware, and tend to its application in connection with electric installations, where its usefulness consists in its high electrical resistance.

We have received the prospectus of the *National Home Reading Union*, the office of which is at Surrey House, Victoria Embankment, London. The objects of this Union are to develope a taste for Recreative and Instructive Reading among all classes of the community, and to direct Home Study to definate ends. The "Science Course" mentions several books well adapted for this purpose. Dr. Paton, of Nottingham, is the General Secretary, George Howell, Esq., M.P., Secretary of the Artizan's Section, and Miss Mondy, Secretary of the Young People's Section and Office Secretary.

ONE of the most remarkable adaptations to the lime-light lantern is the "Zoopraxiscope," used by Mr. Eadweard Muybridge to illustrate his lectures on "Animal Locomotion." The apparatus consists of an ingenious adaptation of the well-known toy known as the praxinoscope, which enables the figures to be projected on the screen and the proper motions exhibited to the audience. The results of this contrivance are, indeed, wonderful, and the motions of animals depicted by its aid are faithful to nature and scientifically accurate.

A BIBLIOGRAPHY of the writings of the late W. Thompson Watkin, author of *Roman Lancashire* and *Roman Cheshire*, compiled by Messrs. Ernest Axon and Thomas Formby, has been published in pamphlet form, extracted from the *Transactions of the Lancashire and Cheshire Antiquarian Society*. The list, which will be most useful to students of the Roman period, comprises papers and other works by the lamented author extending from 1871 to 1888.

THE playful porpoise is the victim of the latest extermination edict. So serious have the depredations of these creatures become in damaging the nets of fishermen on the French coasts that the Government have endeavoured to lessen their numbers by offering a reward per head, and by other remedies. Attempts to catch them by nets have altogether failed, for the porpoises simply jumped over the nets and were at large again. A gun-boat was obtained and the porpoises fired at, but, although the cannon and torpedoes scared them away for a few days, they scared away all the fish as well!

NEXT year the microscope will celebrate its third centenary, being invented in 1590 by a Dutch optician, Zacharias Janssen. On the occasion an exhibition of microscopes and microscopical apparatus will be arranged at Antwerp.

ATTENTION is being directed by physicians to the effects produced by a continual use of the telephone. Nervous excitement and hyperæsthesia of the hearing and of the ear itself are said to be induced, in addition to other more alarming symptoms. Fortunately, these troubles seemed to be removed by complete rest. From our own observation, we should say that the habit of holding the telephone receiver too close to the ear is responsible for many of the troubles which have been noticed.

A DISGRACEFUL depredation of a famous archæological relic has just been perpetrated. The "Wilmington Giant" is one of the historic curiosities of Sussex. It was recently cleaned by a clergyman, who went to great expense in laying white bricks where they were needed. These white bricks have been removed and a flaring inscription, said to be the motto of the Salvation Army, has been brought out in startling letters. It is to be hoped that the Act for the Preservation of Ancient Monuments will be put in force against those who may be found guilty of this outrage.

A REVISED programme of examinations in connection with the Union of Lancashire and Cheshire Institutes has been issued. In the elementary examination a certificate of the first or second class will be given for success in each subject, and a Society of Arts certificate of the first or second class to all who pass in arithmetic, English, English history, and British geography. In domestic economy an extended syllabus is given, including: Food—its composition, nutritive value, preparation, and culinary treatment; clothing and washing; the warming, ventilation, and cleaning of the dwelling; management of a sick room; needlework; the ordinary requirements of a household in sewing, knitting, &c. In the commercial and special subjects the certificates will be of the first, second, and third class, and the standards respectively 85, 65, and 50 per cent. In commercial arithmetic a knowledge of the coinage of the United States and India is necessary; and in German the translation of English into German is required. In phonography for the first class the speed test will consist of 360 words in three minutes. In commercial geography and history special questions will be set on the British Islands, Canada, and Cape of Good Hope, while the special commercial product given is tea.

THAT zoological curiosity, known as the "mermaid manatee," which has attracted so many visitors during the last few months to the Zoological Gardens, has succumbed to the severities of our climate. Up to a few days of its death the animal fed heartily. This manatee has lived longer than any specimens previously exhibited in this country.

AS may be remembered the well-known earthquake prophet, Professor Rudolf Falb, of Vienna, predicted that July 12 would be a "critical" day, in consequence of the nearness of the moon to the earth at the time of a lunar eclipse, and we now learn that earthquakes and terrific storms occurred in the following places:—In Central Asia the town of Tocharkent was destroyed by an earthquake, whilst a tornado passed over the province of Silesia, doing immense damage. Suabia and Franconia were similarly ravaged, as well as parts of Bohemia. Finally, a shock of earthquake was felt in New York. Professor Falb, therefore, claims that his prediction was fulfilled.

THE Norwegian journal, *Naturen*, reports a remarkable instance of rapid growth of a specimen of the *Rosa canina* in an island on the west coast, having since the middle of May attained a height of 4½ metres, being equal to 3·3 centimetres a day, and 1·5 millimetres an hour—a rare occurrence in that latitude. In this island are also to be found some of the largest specimens in Norway of *Ilex* and *Hedera helix*, viz., one 35 metres in height of the latter, and several over 15 metres of the former.

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THE canals of Mars, which are puzzling astronomers so sorely, have received another explanation, Dr. Meisel, of Halle, maintaining that they are due to an optical illusion, as if there were really canals filled with water the great evaporation would cause the formation of a cylinder of steam above them, which, by the refraction of the light, would reproduce an apparent double surface line of water. The density of Mars being one-ninth of that of the earth, the gravity upon its surface is less. This would cause a far greater evaporation of water than on the earth, in spite of a lower temperature probably prevailing in Mars, with a heavier evaporation, which causes the optical illusion.

MR. ROBERT BAYLY, member of the Marine Biological Association, and well known for his interest in biological research, recently paid a visit in his yacht "Alkelda" to the salt-water fish hatchery in the Christiania fjord, near Arendal, which has proved so successful, and he has become a member of this fish culture association.

Some twenty years ago the river pearl fisheries of Northern Russia, in the White Sea, and adjacent waters were very productive, but have since fallen off, the only rivers where they are still carried on being the Kem, Niva, Kola, Tuloma. The fishing is still carried on with the most primitive gear. One hundred mussels yield on an average one large and two small pearls. In the river Niva the fishing is carried on largely by children, but in the Kola the mussels are found at so great a depth that they can only be reached with difficulty. However, a society has been formed in St. Petersburg to carry on pearl-fishing on a large scale with improved apparatus, and as it has been found that the mussels are most plentiful where the trout is also abundant, the Pesckow rivers are at first to be tried, where there is much trout, and where formerly also valuable pearl fisheries.

Prospectuses received from the *Liverpool School of Science* and *Liverpool Science and Art Classes*, show that these institutions are providing excellent instruction in science and art, in the teaching of which, during past years, they have both been very successful. The opportunities for study afforded by these classes, together with those given by the University College, Liverpool Institute, and other bodies, show that Liverpool is doing really good work in furthering instruction both in science and art.

THE corner stone of a new building for the Ossett Mechanics' Institution and Technical School has been recently laid by Mr. Joshua Wilson, of Gledhow, Leeds. The Mechanics' Institution was formed so long ago as 1850, but within the last four years there has been established, greatly through the instrumentality of the Ossett Chamber of Commerce, a most important adjunct in the shape of the Technical School. In spite of the disadvantages under which the latter has been hitherto carried on, in hired rooms designed for other uses, it has proved very successful. Art, science, and technology have been taught to a considerable number of pupils with creditable results, and several of the pupils have acquitted themselves well at the recent examination in cloth manufacture held in connection with the City and Guilds of London Institute for the Advancement of Technical Education. An eligible and central site has been purchased in the new main thoroughfare, Station Road, and contracts have been let for the erection, which will cost about £2,000. A certain amount has been already subscribed, but, after paying for the site, a further sum of about £1,500 will be required to complete and furnish the building. Architecturally the style of the building is conventional, partaking of the seventeenth century character. It has a frontage of twenty-six yards to Station Road, and consists of two storeys and basement. The basement comprises three commodious class-rooms. On the ground floor there will be reading-room, library, committee-room, two class-rooms, lavatory, &c.; and on the upper floor the school of art and laboratory, lecture-room, ante-rooms, &c. The masonry of the basement is well advanced, and the building is expected to be completed early in next year. Mr. C. Milnes Gaskell, M.P., Sir Henry Mitchell, Mr. James Hanson, the Mayor of Wakefield, and others made speeches on the occasion.

Degenerating Blood-clot.

BY A. H. TAYLOR.

Part II.—RED CORPUSCLES.

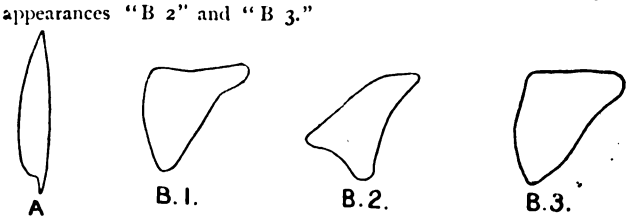
THE changes in the red cells during the decay of a blood-clot are also interesting. In the case of which details are given below, the clot (bullock's blood) was kept partially immersed in a solution composed as follows :—

Na Cl (Chloride of Sodium)	5·39 grammes per 1000 parts water.
$Na_2 SO_4$ (Sulphate of Soda)	0·24 ,,
$Na_2 HPO_4$ (Phosphate of Soda)	0·05 ,,
$K_2 SO_4$ (Sulphate of Potash)	0·414 ,,
$Na HCO_3$ (Bicarbonate of Soda)	1·16 ,,
$Ca H_4 P_2 O_8$ (Phosphate of Lime)	0·24 ,,
$Mg_2 (NH_4)_2 P_2 O_8$ (Phosphate of Magnesia and Ammonia)	0·022 ,,
Glucose	1·2 ,,
$C_6 H_5 COOH$ (Benzoic Acid)	0·2 ,,

Twenty-four hours after death some of the red discs were noted to be crenated, a few slightly peaked, others normal, all moving a little. One or two micrococci were present, but no other forms of bacteria were observed.

On the third day they were more crenated, the white were fewer, micrococci and other bacteria were present.

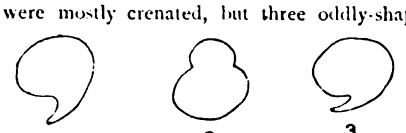
On the seventh day the red discs were noted to be moving a good deal, and some of them were of odd shapes. A long-shaped one ("A") was specially marked; it gave suddenly a slight spring forward, and appeared to change into the ordinary crenated shape. A few minutes later another, similarly shaped, was observed to do the same. Another, somewhat triangularly-shaped ("B 1"), assumed successively the appearances "B 2" and "B 3."



Others had the following irregular shapes :—

These and all others in the field became smoothly round when heat was applied, and the slight to-and-fro motions seemed to be appreciably less. This may have been owing perhaps to the heat having made some of the various bacteria less active. On withdrawal of heat some of the red discs again became crenated.

On the ninth day after the bullock's death the red discs on the slide were mostly crenated, but three oddly-shaped ones were found and watched while heat was applied. When the spirit lamp had been used for an hour, almost all the red cells on the stage were



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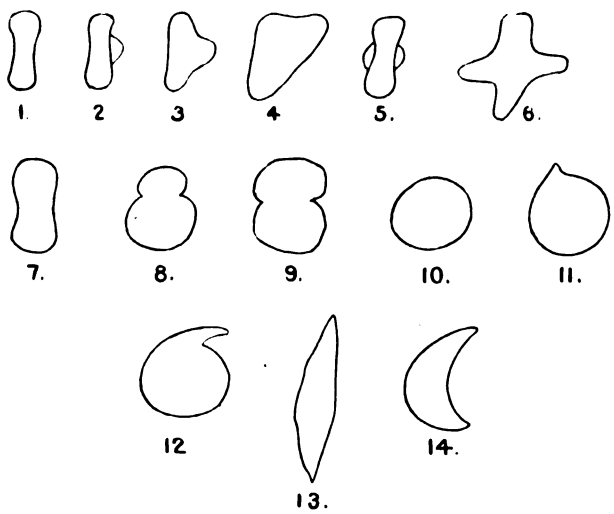
round and smooth, but those three were not so. Later they slowly altered, the points becoming smaller and blunter until the cell passed into the perfect round. By this time many of the red corpuscles had faded away altogether. The lamp was then extinguished. About an hour later No 3 began quiveringly and slowly to put out a point, again withdrew it, and rested for a minute as a curved oval, became nearly round once more, and after one or two such quivering motions returned almost to its original hooked shape—the only one of the three observed that did so. The bacteria were not all destroyed or made quiet by the heat, though perhaps some may have been; some of them continued whirling and forward motions.

Examination of a slide from the same clot on the two or three following days gave much the same results, the red discs becoming smoothly round when heat was applied gradually and long enough.

In other experiments similar appearances were observed, though often the shapes were less striking, and it was not again found possible so to fix on one corpuscle as to recognise it if, after becoming round, it regained its old form.

A certain gradation from the ordinary to the oddest shapes may be traced as a possibility. Thus No. 2 and No. 3 are not uncommon, and may perhaps be stages on the way to the rarer No. 4. No. 5, seldom seen, may be passing into the extraordinary No. 6, seen only once. So also 7, 8, and 9, while No. 11 might, one would think, be a precursor of 12, 13, or 14.



The misshapen cells are most noticeable after the red discs have begun to fall from the clot in such quantity as to tinge the water. The part of the clot (centre, upper, or lower side) from which the piece for the slide is taken also seems to influence the number of them to be found in the field. On first fixing the slide—a moist cell was always used—crenation and movement of the red seem occasionally to be more marked than an hour later; the teazing of the bit of fibrin with a needle may well be supposed to exert an irritative influence. The composition of the liquid which moistens the clot probably exerts an influence. Heat evidently does. Often the long-shaped cells, of which a figure has been given, are found near the edge of the drop, some of them being much more oval than the figure. Then one is inclined to think currents may have something to do with the shape, especially as one watches just beside them a red disc changing its curve for a straight line at the light touch of another. But these long-shaped corpuscles, though oftenest found at the edge, are also to be seen near the centre of the drop.

Both the rapid movements above referred to may be accounted for by supposing that the cell moved possibly by a bacterium—suddenly changed its position, a rod being apparently round when seen from above down. Many other changes of form observed, but not mentioned in this paper, find a possible explanation in this supposition, but it will hardly explain the change of all cells in the field, crenated and otherwise, to smooth, round shape when heat is applied. Evidently this agent has, at a certain stage of decay of the clot, a hurtful influence, for several times it was noted that many cells melted away. They were, however, in an unhealthy state, and were disappearing without the aid of heat, though that expedited matters.

(To be continued.)

Museum Notes.

A NEW Natural History Museum has been opened in Vienna. It is the largest building of the kind on the continent. It is situated in the square, facing the Ring-strasse, and near to the Art Museum now in course of erection. The Natural History Museum has been built by the Emperor at his own cost, to contain the Imperial collections, hitherto scattered about the different palaces and Government buildings. The Imperial family have been energetic collectors ever since 1748, when Francis I. bought a fine collection of minerals from the Florentine, Baillon. The external appearance of the museum is described as being very handsome; the front is massive and terminated by a marble balustrade and lofty cupola, above which rises a statue of Helos. Figures of distinguished naturalists occupy ornamental spaces in the exterior. Inside, the building is adorned with marble statues and artistic frescoes. The museum comprises 43 galleries, in four stories, the ground-floor being devoted to the official apartments, store-rooms and laboratories, whilst above are placed the geological, prehistoric, and ethnographical collections. Lofty rooms are provided for animal specimens, and the anthropological department includes some thousands of skulls and skeletons of all races.

THE well-known Museum at the *Jardin des Plantes*, at Paris, has just been installed in new quarters. Two large galleries occupy the front of the building, and the large hall at the back contains three stories of galleries for the reception of the zoological collections. Amongst these are three huge trophies: the first comprising a group of wild beasts surrounding a monster elephant; the second including the chief reptiles and amphibia, with six large whales; and the third comprising birds and small animals.

MR. W. FLINDERS PETRIE draws attention, in the pages of a contemporary, to the necessity for a more satisfactory method being devised in regard to the cataloguing of museum specimens. The greatest trouble is that caused by the placing of new additions in the catalogue in their proper places. Usually such additions are distinguished by letters, as 5671*a*, 5671*b*, and so on. This plan was the one formerly in use at the British Museum. Mr. Petrie advocates what may be termed "fractional cataloguing," all numbers being treated as decimal fractions and arranged accordingly. By this system any quantity of new additions may be placed at any time in their right order in the catalogue; thus, fifty new specimens of an object, number 371, would be numbered 371·01 to 371·50. It is recommended also that all museums should agree upon accepting a specified set of 100 or 1,000 numbers to subdivide each branch of science; the numbering of additional examples in right order could then be done without any difficulty at any time by using after the initial, or whole number, an indefinite series of decimals.

UNDOUBTEDLY, this system of "classified cataloguing" has much to recommend it, some of the principal advantages being the ease with which a collection, or any part of it, could be re-arranged, and the readiness with which any object in the catalogue could be found by reference to its number. As against these, the chief disadvantage seems to be the difficulty of arriving at the actual number of specimens in the collection, except by counting them. This, we think, could be obviated by numbering consecutively, in brackets, each object, when received, in the record book, irrespective of its natural order, this record-number, however, not to be used as a reference-number in the catalogue.

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WHILST most museum curators will be agreed that some uniformity, both of museum arrangement and cataloguing, is desirable, it does not follow that the system above indicated will be found the most suitable in every case. We shall be happy to hear from correspondents interested in the question, and also to publish any suggestions having a useful bearing upon the matter which may reach us.

DR. HENRY WOODWARD has secured for the British Museum the valuable collection of vertebrate remains of Lower Pliocene age from the Island of Samos, obtained in 1887, by Dr. C. Forsyth Major. The collection includes several types of great zoological interest.

MR. WRAY, of the Museum of Perak, has described a small beetle infesting the mangoes in Perak, similar to the mango-weevil pest which has committed great depredations in India. Mr. Wray points out that, as certain varieties of the mango-tree enjoy immunity from the insect's attacks, it may, eventually, be possible to raise, by selective processes, good varieties of this fruit which would not be subject to the attacks of this beetle.

THE retirement is announced of Mr. R. Bullen, the keeper of printed books at the British Museum.

THE committee appointed by the Treasury to examine into the question of the scientific collections at South Kensington under the control of the Science and Art Department, have now made their report, from which it does not appear that any gain would result from the "weeding out" process so fir nly advocated by certain members of Parliament when the subject was lately under discussion. The committee, which consists of the following members, Lord Rayleigh, Dr. John Evans, Sir H. E. Roscoe, Sir Douglas Galton, Francis Hervey, B. Samuelson, and S. E. Spring Rice (secretary), has recommended that an additional exhibition space of about 90,000 square feet should be provided without delay. This additional space would "suffice for the requirements of a creditable science museum," and includes provision for a scientific structural collection (applied science), but "does not include any provision for offices, workshops, warehouses, or other accessories to such a museum."

MR. A. S. WOODWARD, F.G.S., contributes to the August number of the *Geological Magazine* an interesting article on the Palæontological collections in the Malton Museum, regarding which he says that "it would be difficult to find one of more scientific interest and importance" among local museums of recent formation.

THE almost priceless museum which Mr. Ruskin formed some years ago at Sheffield, and which belongs to St. George's Guild, has been formally handed over to the Mayor and Corporation of that town as its custodians for twenty years. For some time past efforts have been made by leading members of the Corporation to obtain possession of the museum as a gift to the town, but for various reasons these efforts were unsuccessful. Recently further overtures were brought about by the fact that the Corporation had purchased a mansion and park in the neighbourhood of the town, the latter as a public park and the former as a museum. These overtures were fortunately more successful. Inasmuch as the museum is the property of the members of St. George's Guild, neither Mr. Ruskin nor the trustees are in a position to give it to the town; but they have entered into an engagement by which the museum is to be lent to the Corporation for twenty years. As soon as possible the contents of the museum will be removed to Meersbrook Hall, the mansion above referred to. This is situate in the midst of a beautiful park on the outskirts of a part of the town which has of late years grown with much rapidity.

LIVERPOOL CORPORATION LECTURES. — Arrangements are now completed for the usual autumnal course of lectures, delivered under the auspices of the Library, Museum, and Arts Committee of the Corporation, at the Rotunda Lecture-hall, in William Brown-street, which commence in October, and will this year be on a larger scale than has hitherto been attempted. Last year the course given in the same hall marked a decided advance in public lecture enterprise in Liverpool, and the eminent lecturers who have been engaged for this season are likely to attract even greater interest. Some of the leading literary and scientific authorities of the present day will visit this city, and the public will thus have the opportunity of hearing their admirable discourses at a charge for admission which is merely nominal. There will be over 1,000 good seats at a penny, and the floor of the hall will be reserved at a slightly increased charge. The following is a list of lectures and subjects:—Professor J. Norman Lockyer, F.R.S., two lectures on "Meteoric Hypothesis;" the Rev. H. Reginald Haweis, M.A., on (1) "Music and Noise," and (2) "Music the Art of the Age;" Professor T. W. Rhys Davids, LL.D., two lectures on "The Rise and Early History of Human Culture;" Edmund Gosse, M.A., Clark Lecturer in English Literature, Trinity College, Cambridge, two lectures on "The Poetry of the Reign of Queen Victoria;" Professor Oliver J. Lodge, two lectures on "The Electric Telegraph;" George J. Romanes, F.R.S., two lectures on "The Scientific Evidences of Organic Evolution;" and Alfred Russell Wallace, LL.D., F.L.S., on (1) "The Origin and Uses of the Colours of Animals," and (2) "On Warning Colours and Mimicry."

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between August 16th and September 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met Soc., Astronomer to the Mersey Docks and Harbour Board:—

(*a*) Barometer	Highest (September 15 h)	30·48	Inches
,, ,,	Lowest (August 20th)	29·10	,,
,, ,,	Mean	30·010	,,
,, ,,	,, for 22 years August	29·925	,,
,, ,,	,, ,, September	29·915	,,
Temperature	Highest (September 10th)	72·5	Deg. F.
,,	Lowest (September 6th)	48·9	,,
,,	Mean	58·9	,,
,,	,, for 22 years August	60·4	,,
,,	,, ,, September	56·2	,,
,,	,, of Evaporation	55·4	,,
,,	,, ,, for 22 years August	56·4	,,
,,	,, ,, ,, September	52·8	,,
(*b*) Rainfall	Amount	2·228	Inches.
,, ,,	,, Mean for 22 years August	2·706	,,
,, ,,	,, ,, ,, September	3·356	,,
,,	Number of Days on which Rain fell	12	
,,	Greatest fall in 24 Hours (August 23rd)	0·818	Inches
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·2	
,,	,, ,, for 22 years August	6·4	
,,	,, ,, ,, September	6·5	
(*c*) Wind	Velocity, Greatest (August 20th)	55	Miles.
,,	,, Least (September 3rd)	1	,,
,,	,, Mean Hourly	15·1	,,
,,	Greatest Pressure on Square Foot (Aug 20, 8-40a m.)	34·0	Pounds.
,,	Direction at time of Greatest Pressure	W	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
9	90	158	51	92	220	108	16	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

THE WEATHER.

August 15 to September 14, 1889.

The weather during the third week of August continued very unsettled, cloudy, and wet, with low barometrical pressure but equable temperature. The weekly averages were:—Barometer 29·609 in.; mean temperature (corrected for daily range) 55·85°; relative humidity

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80%; total sunshine 15 hours 35 minutes; rainfall 1·730 in.; wind Westerly. From the 22nd to the 26th similar meteorological conditions prevailed. On the 27th pressure increased considerably, the weather became brighter, and no rain fell during the last four days. Averages for the 10 days:—Barometer 29·958 in.; temperature 54°; humidity 81%; sunshine 32 hours 45 minutes; rainfall 0·986 in.; wind Westerly.

The mean atmospheric pressure for August, 29·812 in., was about 0·13 in. below the average, unsteady, wide range, and 17 oscillations. The mean temperature (corrected), 55·21°, although rather higher than the corresponding month in 1888, was 2° below the average. The warmest day, 62·38°, occurred on the 1st, and the coldest, 50·28°, on the 25th. The means of the thermometers in the shade, and of the exposed black and bright bulbs *in vacuo*, were very near those of last August, but those in the earth and the one in water show an excess of 2°. Rain fell on 24 days to the unusual depth of 6·836 in., nearly 3 in. above the average. The first 26 days were changeable and wet, and retarded the work of harvesting; but rapid progress in reaping was made during the last few days.

During the first week of September a system of anticyclonic conditions prevailed generally in Western Europe, and, with the exception of the 2nd, fine autumn weather war enjoyed. Averages:—Barometer 30·197 in.; temperature 58·9°; humidity 78%; sunshine 17 hours 40 minutes; rainfall 0·531 in.; wind Easterly. From the 8th to the 14th settled, fine weather continued, and the greater portion of the harvest has now been secured. Averages;—Barometer 30·178 in.; temperature 58·65°; humidity 87%; sunshine 9 hours 20 minutes; rainfall 0·172 in.; wind variable.

W. W. Midgley, F.R.Met.S.

Met. Observatory, Bolton, September 18, 1889.

Sheffield.

Meteorological Summary.

August, 1889.	Temperature. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min	Means for Aug. Daily Max.	Daily Min.	Rainfall. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date	Mean for Aug.* Ins.
Sheffield ...	77°	30th	46°	25th	59°	—	—	2·74	18	0·76	19th	—
Spurn Head.	72°	2nd	47°	25th	59°	—	—	2·59	21	0·88	11th	—
York	74°	1st	43°	25th	59°	68°	51°	4·49	20	0·49	19th	2·47
Barrow	64°	2nd	40°	21st	58°	—	—	5·72	22	0·98	14th	—
Liverpool ...	69°	16th	50°	25th	59°	66°	54°	3·98	20	0·82	23rd	2·79
Holyhead ...	68°	15th	49°	25th	58°	64°	55	3·46	17	0·85	19th	2·89
Oxford	82°	30th	43°	25th	60°	69°	53	2·27	15	0·54	9th	2·33
London	83°	30th	44°	25th	61°	72°	54°	2·23	17	0·34	5th	2·20

The means of Temperature and Rainfall for August are for 15 years.

August 16 to September 15, 1889.

Pressure.

On August 16th pressure ranged from 29·6 in. in the N. of England to 30·0 in. in the S., and on the 17th there was a decided fall to 29·2 in. in the N. and 29·8 in. in the S. There was a steady increase of pressure on the 18th, but a further fall on the 19th, when pressure only varied between 29·6 in. and 29·7 in. all over the kingdom. A depression, with its centre over the middle of the country and readings down to 29·1 in., was slowly passing on the 20th, and on the 21st it had passed to the N. of our islands, but another deep depression was approaching from the W. This had travelled across the country on the 22nd and pressure was recovering, but was still very low, and it continued to improve on the 23rd and 24th, and was still rising slowly on the 25th, when it ranged from 29·7 in. to 29·9 in. The barometer continued to rise on the 26th and had reached 30·0 in. in most places, and was still going up on the 27th, but a further fall set in on the 28th in the N., where the barometer fell to 29·6 in., being as high as 30·2 in. in the S. There was a brisk rise on the 29th and 30th, when pressure was above 30·0 in. in all parts of the country, and it remained high till September 2nd, when there was a slight fall in the W., but the depression was shallow and passed away the next day. On September 4th the barometer was above 30·1 in. all over England, and above 30·2 in. on the 5th, and remained above 39·0 in. till the 9th, when there was a decided fall in the N. to 29·8 in. On the 10th pressure again recovered and reached 30·0 in., and continued very high till the 15th, when the barometer readings were 30·4 in. in all parts of England.

The Weather.

During the week ending August 24th the weather was of a very unsettled character, being wet and stormy, gales of considerable violence being experienced, especially in the S. Temperature was very low for the time of the year, the maximum readings not exceeding 60° in many places. Rain fell on six days at Spurn, York, Barrow, Liverpool, Holyhead, and London, and on five days at Sheffield and Oxford, and the amounts were large. The following week, from August 25th to 31st, the weather underwent a decided change, the conditions being chiefly anticyclonic, with a large amount of bright sunshine, light winds, high temperature, and very little rain. During the latter part of the week the maximum temperature in London, Oxford, and other places exceeded 80°. Rain fell on two days at Sheffield, Spurn, York, and Barrow, and one day only at Liverpool, London, and Oxford, and there was no rain at Holyhead. From September 1st to 7th the weather was variable, being fine at the beginning of the time, but between the 2nd and 4th thunderstorms occurred and the air was close and damp, but the rainfall was not heavy. Afterwards the weather again improved, and it was dry and the air warm, though there was a large amount of cloud at times, and frequent fogs. Rain fell on four days at Holyhead, three at York and London, two at Sheffield, Spurn, Barrow, and Liverpool, and one at Oxford. The week ending September 14th was characterised by fine weather on the whole, though fogs were of frequent occurrence, and slight showers occurred at times, especially in the W. and N. Temperature again rose high, and maximum readings of 80° and more were registered at London, Oxford, and other inland places. Rain fell on three days at York, Barrow, and Liverpool, on two days at Spurn and Holyhead, and there was no rain at Sheffield, Oxford, or London.

Sun Spots.

The two groups of sun spots which were near the western limb of the sun on August 15th were still visible on the 16th, but had disappeared on the 18th, while the small spot which was near the centre of the disc continued visible till the 18th, but had disappeared on the 20th. No further spots were seen till the 28th, when there was a nearly circular spot with well-defined penumbra just within the eastern edge of the disc and very far S. It travelled across by the sun's revolution without undergoing any decided change, and had totally disappeared on the 10th of September, since which date to the 15th the sun has been immaculate.

E. Howarth, F.R.A.S.

Museum and Observatory, Sheffield, Sept. 20, 1889.

Artificial-Light Photography.

By J. F. Simmance.

Since the introduction of photography, scientific labour has been incessantly directed in the two directions of improving results and facilitating production. But, until recently, all attempts to deal with the main factor, viz., the light itself, have only terminated in impressing deeply upon photographers the necessity of familiarizing themselves with the varying conditions of daylight and their effects upon different makes of sensitized plates. In the end this has been effected, and has become almost a second nature. It is difficult for a non-professional sitter to appreciate the rapidity with which the operator gauges the actinic capabilities of the prevailing light, and gives to a

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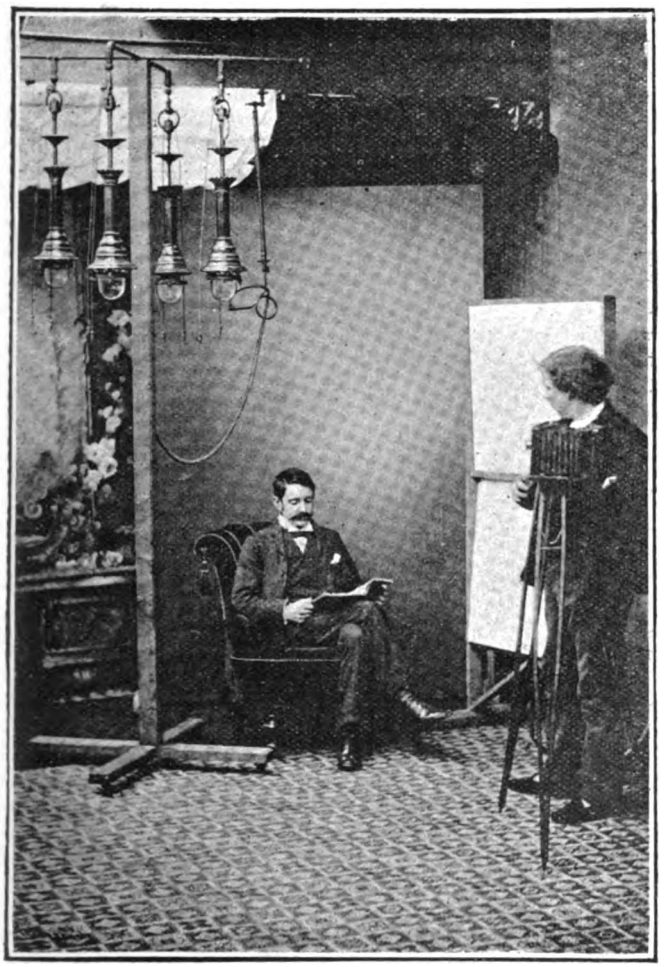
second the requisite exposure. When it is considered that it is not amount of light, but its character, which produces the picture, and that the operator unconsciously (by reason of his long experience) can tell intuitively whether the character of the light has altered, and in what way, it strikes one as marvellous that the eye should become such a sensitive gauge. The possession of this faculty constitutes a photographer. From morning till dusk he will be at work, with sitter after sitter, perhaps 80 per day, and probably for no consecutive hours is the same exposure required or given. Days of one continued and sufficient light would facilitate photography immeasurably, but in our climate they cannot be hoped for.

It is not wonderful that attempts innumerable should be made to procure an artificial light subject to no variation and of known actinism,



but electricity alone has until now proved a sufficient substitute for daylight. Probably, if it could be procured at a cost of, say, 2s. 6d. per day, we should have no more daylighted studios, as in the one or two cases where it is used, and the *clientele* is sufficiently numerous and wealthy, daylight is entirely excluded, and all work is done by electricity. But in most cases the cost is far too great, and the accommodation (for plant) too limited, and so daylight, which costs nothing, is the only method adopted. Gaslight has been tried many times, and always discarded. The magnesium flash and kindred sources of illumination are occasionally used, but for portraiture have not often been successful. The light for efficient focussing is absent, and the flash, as a rule, causes a bad expression on the sitter's face. In fact, of a dozen photographs made by the flash, very few firms (with reputations to lose) would venture to append their names to three of them as specimens of portraiture.

A system of lighting for photography, developed by Mr. Richard Brown, the well-known photographer, of 35, Bold Street, Liverpool, in conjunction with the firm of William Sugg & Co., of Liverpool, and assisted by Mr. Wm. Mackey, consisting of an arrangement of D. W. Sugg's patent Cromartie gas lamp, appears to give results which approach more nearly to those of daylight than any system other than electricity. The cost of installation is but some few pounds, and the cost of gas about one penny farthing per hour. Messrs. Sugg & Co. many years ago produced some very fair pictures by means of series of flat flame burners, but with long exposure, and of course with wet plates. The next development was a series made by Mr. Laws, of Newcastle, with Sugg's Compound Argand (concentric rings), when ordinary photographs were produced with 1½ minutes' exposure. The latest Cromartie experiments show that it is possible, with ten or fifteen seconds' exposure, to obtain pictures undistinguishable from good daylight pictures, and with a peculiar softness and charm about them that is rarely seen in ordinary daylight work. These results are now known generally through the press, and with these facts we have nothing to do. Our point is to examine the causes of the great acceleration in time. The tendency would be to attribute it at once to increased sensitiveness in plates, but the experimenters with the Cromartie lamp ascertained that this is only one of the factors. The early trials with wet plates were performed upon a sort of stage encircled with gas lights giving, perhaps, an aggregate yield of 2,000 candles. Then, with the same plates, the Argand of about 600 candles did the work in less time, and, we believe, with the same description of lens. Then, with Ilford plates, comes the Cromartie trials, when ten lamps of 100 candles each were used, which provided better pictures, but with the same exposure as the 600 candles in Argand with wet plates. Later, the power of Cromartie lamps was reduced to 400 candles (from 1,000 candles), and fifteen seconds sufficed to produce the photographs concerning which so many newspaper articles were written, and which appear to show the question of artificial lighting as solved. It would be premature to consider this as the end of the matter, as the London Stereoscopic Co. are now busily engaged in London upon further experiments, but we may glance at the different results obtained and point out the difference in the quality of the lights used. The flat flame burners, burning in the open without the use of any artificial method of inducting air, come out worst, then the Argand (made as a lighthouse, or similar burner), with four concentric rings of flame, encircled by a glass chimney inducing a powerful intake of air, but deflecting obliquely upon the flames, comes next. The Cromartie, with a more rapid surface combustion, air impinging at right angles on either side of the flame gave, with a much greater illuminating power, only the same result as the Argand, but the same lamp arranged to consume more gas, and so supplied with air as to give a smaller result in light per foot of gas burnt as shown upon the comparative disc of a photometer, produced the best results in actinism. The structure of this Cromartie is simply that of a gas burner pointing downwards, perforated with holes horizontally, burning at the base of a tube which causes a rapid draught. The lower part is enclosed in a glass globe into which air has free entry above its upper rim, and a secondary current enters by two openings straight from the outside to close above the burner. Thus it is obvious that no attempt is made to *heat* the incoming currents (which attempt is known generally as the regenerative system), and yet the result of this simply-constructed lamp is to develope the illuminating powers of coal gas to an extent far beyond the limits of the regenerative principle as embodied in lamps so called.

One remarkable feature in the experiments should be noticed. The interior of the lamp behind the flame was on one occasion painted red, with the result of giving the light a distinctly reddish appearance. Yet the results upon the Ilford plates were in no way affected; the exposure

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was as rapid as when a white background rendered the same flames dazzlingly white. The summing up of the whole experiments may be put in a few words. A light may be obtained from gas which renders the photographer independent of the weather; a snowy day covering his glass-roofed studio with six inches of snow is no more an inconvenience. The same exposure may be given (with the same plates) time after time, with similarly good results, night and day. Summer and winter will be alike to the photographer who need never disappoint his sitters, and whose hay-making hours need no longer be limited to sunshiny ones.

Notes on Some Natural Resemblances.

By F. P. Marrat,
Free Public Museum, Liverpool.

During observations extending over a large number of years, I have been much interested in noticing the curious and pleasing fact that certain specimens in different groups of natural objects resemble each other so greatly that the mind of the student is at once struck with the reflection—May not the whole have been modelled after the plan of a few original types? The examples which I am about to give in this paper are only selected from such objects as readily present themselves, without paying any regard to the relationship or the affinity that might be supposed to exist amongst them. All that is aimed at is the general resemblance which they bear to each other.

The materials from which these observations have been drawn are contained in the drawers of some of the table-cases exposed in the Free Public Museum, Liverpool, and may be seen in Bird Rooms Nos. 1, 2, and 3 on the right hand side of the Stone Gallery, which is reached at the top of the stone steps facing the entrance.

Taking, firstly, the Mineral Kingdom, we find but few examples here afforded for comparison in consequence of the rigidity of most of the species. A single specimen of Chalcedony in my own cabinet is the only one that may be said to resemble a plant. This piece is remarkable for its general resemblance to a tree fungus, known to botanists as a *Polyporus*. Everyone is acquainted with those curious dendritic markings so frequently seen on the various slates, leptinites, old red sandstones, &c. A charming specimen occurs in the second case on the left hand side of the centre space of the Phillip's Collection in the Liverpool Museum, in which white Gotham marble forms the *base* and the beautiful dendritic black oxide of manganese the picture upon it. Landscape-marble, ruin-marble, and ruin-jasper are other examples which may be enumerated in passing. The radiated brown sulphate of baryta, known as Devon marble, much resembles a section of wood, and, indeed, is often mistaken for fossil wood.

From the extraordinary variation occurring among the Fungi, we should naturally expect that some of the species would be found to resemble certain forms in other natural kingdoms. The beautiful little "bird's nest" fungus (*Crucibulum vulgare*) is wonderfully like a small bird's nest, with the eggs lying at the bottom; indeed, it would not be too great a stretch of imagination to suppose that it represented the nest of a tiny humming bird. The sponges, too, which spring up in an almost endless variety of forms, supply us with many typical examples. Thus, the "bird's nest" sponge (*Labaria hemispherica*) closely resembles the actual nest of a bird, not only in form, but in the loose texture of the interior. Two other allied sponges, *Halteria Carpenteri* and *Pheronema Grayi*, are each of this type. Another of the sponges, *Spongia infundibulum*, is fashioned on similar lines to those of the coral, *Turbinaria crater*, both being funnel-shaped. A number of sponges and corals also occur of cup-like or vasiform shape, which are by no means rare, and each of these two groups often exhibits bottle-shaped, calabash and pod-like variations. It does not always follow, as a natural consequence, that resemblances between one living form and another should only arise in closely-allied groups; thus we have the following examples selected from the gorgonids:—*Pterogorgia setosa, pinnata, petechizans*, &c., which resemble the plumes of a bird.

Again, the *Paragorgia arborea* (a northern form of Gorgonid) closely resembles a piece of ginger; whilst the *Phyllogorgia dilatata* has the external form of an oak leaf, and the dainty *Xiphogorgia anceps* in its growth might be compared to some of the narrow leaved ferns.

The narrow, clavate stems of almost any species of the coral genus *Seriatopora* have representative types in the genus *Clavaria*, a fungus. Another form of fungus is so translucent that, in general appearance, it could serve to place side by side with some species of floating jelly-fish, such as *Aurelia*, *Chrysaora*, or *Rhysostoma*. The large masses of semi-circular coral, known as "brainstones," are very much like the labyrinthic meandering markings of the brain. Again, one of the lowest order of corals, *Millepora alcicornis*—so named from the numerous small pores that dot its surface—has several resemblances. It resembles, in the first place, the palmated horns of the elk, and almost every species of deer could find a small set of horns similar to its own amongst the varieties occurring on the rocky sea shore where it is found. *Stylaster* is another very beautiful genus of coral, which, if it were not for its brilliant colours, we might place near the prickly gorse bush. *Lophoseris*, with its rounded, lobed, and radiated branches is by no means unlike the *polyperi* of our trees. Two other forms, *Primnoa* and *Caligorgia* might be compared with the light and open work in the feathers of the heron or egret. *Antipathes* is also much like those last mentioned, but partakes more of the appearance of stiff, bushy, and shiny shrubs. The red coral (*Corallum rubrum*) resembles a strong, thick, repeatedly-branched red tree, the tips of its branches being peculiarly sharp pointed.

Certain corals have the margins of their orifices sharp, meeting at various angles—such as may be seen in the *Prionastrea tessellifera*—a plan which is repeated in the sponge *Tuba plicifera*. Another coral type, *Dichocœnia pulcherrima*, consists of a series of united tubes, having the margin of the apertures rounded as if folded inwards, and a very similar group of *Zoanthids* is found to occur in the genus *Palythoa*.

Numerous examples might be given of the long, slender-branched sponges; but I will only mention a few of the best known instances:—The fresh-water *Spongilla fluviatilis*, occurring in the canals and ponds near Liverpool, and the *Halichondria oculata* (a species found in the Mersey).

Trees have also representative forms in a group of corals named *Dendrophyllia*, amongst which are the Mediterranean scented coral *Dendrophyllia ramosa* and the black coral *D. nigrescens*. That marvel of beauty, *Madrepora echinata*, and several species in the genus *Oculina*, are tree-like in form. Cup-shaped corals, sponges, &c., are comparatively common; one of the largest, as well as the best known species is Neptune's Cup-sponge. Fan-shaped corals and sponges are not so numerous, the former being usually rather small, but they form an interesting group for the student. The Chinese *Flabellum pavoninum*, or peacock's-tail coral, and the following sponges—*Spongia flabellum* and *flagelliformis*, are representatives. In the *Zoanthid* series we find some remarkable specimens, one of which—the *Renilla Americana*—has all the appearance of a fungus with the stem placed in a side slit of the pileus. Those very remarkable objects, the Sea-pens, resemble—as their name implies—a blunt quill with its side feathers.

Although we may not be able to say that certain generic groups always possess any striking likeness to each other, still, the following resemblance in the mode of supplying the progeny who live in closely-allied groups is interesting. The shells of a certain genus of stationary mollusca, the *Tenagoda*, are perforated on one side from top to bottom, so that the water may pass into the tubes of the animal without its being compelled to crawl out. In the coral genus, *Distichopora*, an external

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and perforated slit performs the same office; that is, it conveys water and food without the necessity of moving from its house. Another coral, the prickly *Echinophora*, would well compare with some of the cactus tribe; the circular depressions in the plant, surrounded with radiated, needle-like spines, are by no means dissimilar from these in the coral. I do not think that these spines, either in the coral or the plant, may be viewed as defensive weapons, because the coral has as many holes bored in it by its enemies as most other corals have, and the cactus plant suffers quite as much from the animals which feed upon it as most other plants do.

We can hardly regard this subject in the light of "Mimicry"; at all events, it seems impossible to assign any useful or protective purpose to the fact that one natural object possesses a strong resemblance in *form* to another in a totally different group. Perhaps a more careful study of the subject may throw some light upon it, and we may then hope to find a solution to this rather difficult question.

I have simply called these "natural resemblances," because in the present state of our knowledge they appear to be nothing more noteworthy.

In this subject there is full scope for work in a new field, and one that is certainly not like'y to soon come to an end. In pointing out the variable nature of the objects in the foregoing observations, it will not be the first time that my pen has announced the fact that endless variation is the rule and not the exception to the rule in Nature.

Tests for Divisibility by any Prime Number.

MR. TUCKER, in *Nature* of May 30th, has given a property of the number seven, to which his attention had been drawn by a pupil. I wish to show that the principle there established is of wider application, and, in fact, gives a test of divisibility by any Prime > 5 His proof is—

Let N = 234	5	$u_2 = 234 - 2 \times 5$
u_2 = 22	4	$u_3 = 22 - 2 \times 4$
u_3 = 1	4	

If u_1 u_3 &c. is divisible by 7, then N is:—For

$N = 10 P_1 + p_0$ Now $10 P_1 = 10^2 P_2 + 10 (q_1 + 2 p_0)$

$u_2 = 10 P_2 + q_1$ $10^3 P_3 = 10^3 P_3 + 10^2 (q_2 + 2 q_1)$

$u_n = 10 P_n + q_{n-1} =$ $10^{n-1} P_{n-1} = 10^n P_n + 10^{n-1} (q_{n-1}) + 2 q_{n-2}$

7 Q by hypothesis. $N = 10 P_1 + p_0 = 21 [r_0 + 10 q_2 \ldots . 10^{n-2} q_{n-2}]$

$+ 10^{n-1} (10 P_n + q_{n-1}) = 21 M +$

$10^{n-1} (7 Q) = 7 Q'$

Now, in an exactly similar way, we may show that—

$N = 11 M + 10^{n-1} (11 Q) = 11 Q'$, giving multiplier 1

$N = 91 M + 10^{n-1} (13 Q) = 13 Q'$, ,, ,, 9

$N = 51 M + 10^{n-1} (17 Q) = 17 Q'$, ,, ,, 5

$N = 171 M + 10^{n-1} (19 Q) = 19 Q'$, ,, ,, 17

&c. &c. for any prime number.

I was led to this result by the following consideration. The multiplication table for 17 is—

17 × 0 = 0	17 × 5 = 8·5
17 × 3 = 5·1	17 × 8 = 13·6
17 × 6 = 10·2	17 × 1 = 1·7
17 × 9 = 15·3	17 × 4 = 6·8
17 × 2 = 3·4	17 × 7 = 11·9

&c.

Now we notice (1) that the units' digits are the natural numbers 0, 1, 2, 3, &c., thus obviating all exceptions. (2). That if we multiply the units' digit by 5 (casting out the prime number wherever necessary) we get the figures to the left of the point. This is the main principle of the test. For, if *any number* ends in a certain digit, say 7, and is also divisible by 17, as, *e.g.*, 1547, then the figures to the left of the units' digit will form a number of the form 17 N + 1 (*v.* table). (3). This principle applies to any prime number, except 2 and 5 (as multiples of these two numbers cannot have all the digits in the unit's place).

Is 987654321 a prime number? In actual practice we may proceed to test it as follows:—

```
987654321·1
        5
      42·7
      35
      50·7
      35
      61·5
      25
      73·6
      30
      84·3
      15
      96·9
      45
      5·1
      5
      0
```

The given number is exactly divisible by 17, and no prime. If the *quotient* be desired, multiply the figures to the right of the points, viz., 19365771 by 3 for (17 × 3 = 5·1), and we have at once

987654321 ÷ 17 = 19365771 × 3 = 58097313

We thus have an alternative method to long division. In a future number I may enlarge upon this.

ROBT. W. D. CHRISTIE.

Wavertree Park College, Liverpool.

Trap-door Spiders.

REFERRING to the communication of Mr. Frederick Taylor on Trap door Spiders and their nests, published in our last issue, Mr. Taylor sends us the following interesting account, written by Miss C. F. Gordon Cumming, and extracted from *Granite Crags*, 1884:—

"To-day an Indian boy offered me for sale some beautiful specimens of the *tarantula* Spider, or rather of the Trap-door Spider, as it is called in this country. It is a wonderfully-ingenious architect, and displays amazing skill and patience in contriving and constructing its home, which, in truth, is a fortress, with a strong door to keep out all besiegers. The nest is a little well of clay, sunk in some earthy bank, just large enough to admit an averaged-sized human thumb. The interior is smoothly polished, but the *tarantula* is not content with bare plastered walls. She is a diligent worker, ever weaving dainty fabrics; so she lines her home with a double curtain, a hanging of coarse spider cloth next the wall, and over that a rich white satin material, smooth and glassy. The well-like nest is almost invariably tunnelled into the side of a sloping bank. It is closed by a circular door, fastened at the upper side by a most ingenious hinge. It opens outward, so that when the spider goes out the door falls into its place and closes of its own accord, fitting so closely into the rim of the nest, and covering it so neatly, that no foe would ever notice the little disc in the earthen bank, which is the only trace of the *tarantula's* home. But, to make assurance doubly sure, the wary spider provides means to secure it on the inside. At the side farthest from the hinge it leaves several small holes in the disc, and by clinging to these with its claws it keeps the door tightly closed from the inside, so that no enemy can enter. The door is in itself a marvellous contrivance and a monument of patient ingenuity. Though barely an eighth of an inch in thickness, it is composed of thirty triple layers, each consisting of a coating of clay, lined with two-ply of spider-cloth, similar to the tapestry within the nest. These ninety layers are all fastened together, making a solid door, which is largest on the outside, and fits into a groove, so that it closes quite tight. I suppose sufficient air for breathing purposes comes in at the keyholes. The enemy against which this spider defends itself so securely is a yellow-winged fly belonging to the *Hymenoptera*, which darts upon the spider, stabs and devours it, or even endeavours to scratch open the closed door, behind which its prey has retreated."

The Rev. O. P. Cambridge also sends us a description of a Trap-door Spider from South Africa, which he described in

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the *Field* of October 10th, 1875, and of which the following are illustrations :—

Fig 1

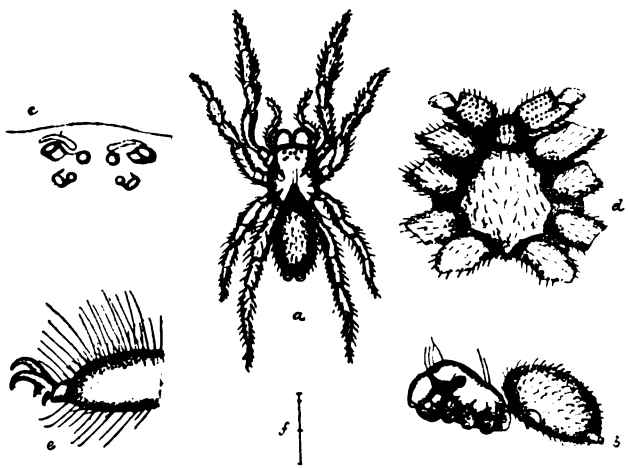

Fig. 2

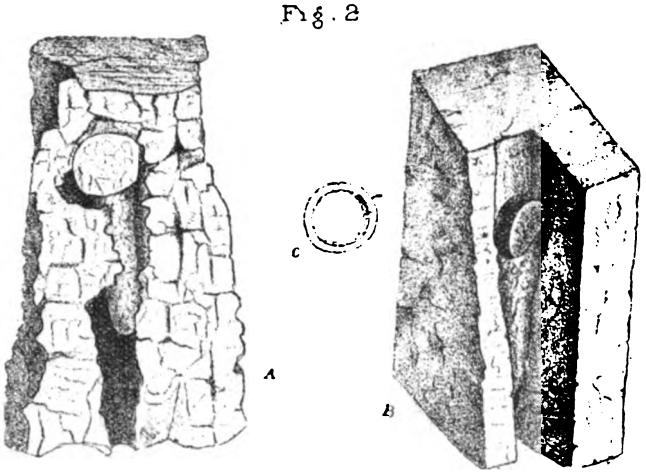

Fig. 1.—*a*, spider enlarged; *b*, ditto, in profile, without legs or palpi; *c*, eyes, from above and behind; *d*, underside of cephalothorax, showing maxillæ, labium, sternum, and basal joints of the legs; *e*, tarsus of one of the second pair of legs; *f*, natural length of spider. *Fig. 2.*—*A*, nest in piece of bark; *B*, another nest, in groove of a piece of wood; *C*, lid of nest detached, showing the inner side.

Respecting this spider, Mr. Cambridge writes—"A single example of this very distinct spider, accompanied by several nests, was received (through the entomological editor of the *Field* newspaper) from South Africa. The nest is a tubular one, formed in the crevices and rugulosities of the bark of the oak tree; it scarcely exceeds an inch and a half in length, and it is closed externally by a hinged lid, of about 4-5 lines diameter. The exposed surface of the tube, as well as the lid, is covered with small particles of the outer bark, and thus exactly resembles the bark itself. The lid is peculiar in combining both the separate types observed in the trap-door nests of Europe, and described in *Harvesting Ants and Trap-door Spiders*, by the late Mr. Moggridge—that is, the *cork* and *wafer* types. It has its central portion thicker than the rest; this part shuts into the circular entrance of the tube, and its thinner rim closes over the edge, entirely concealing the nest. The form of the lid is round, or sometimes slightly oval, and it seems to be placed at the upper end of the tube—*i.e.*, the tube running downwards in the bark. This, however, is not certain, since there is nothing in the detached pieces of bark received to show conclusively in what direction they grew, so it is possible that the tube may run downwards; this latter would perhaps better ensure the keeping close of the lid, since the opening of the tube is oblique, and the lid when closed lies very nearly in the same plane as the surrounding level of the bark. Direct evidence, however, is wanting upon this point.

"I have taken the liberty to connect the name of its discoverer (Dr. Dyer, of Uitenhage, South Africa) with this spider, the finding of which must be hailed as an important addition to our knowledge of trap-door spiders. Hitherto, all known spiders, of trap-door-forming habit, have their tubes made in holes in the earth; and (no doubt to assist in excavating them) the upper fore extremity of their falces is furnished with strong spines. In the present spider, whose nest is made in channels already existing, the crevices and rugulosities of the bark of trees, there is no need of such spines, and their absence is thus accounted for. An interesting speculation suggests itself here, *i.e.*, whether the present spider is prior, or subsequent in point of genealogical relationship, to the trap-door spiders that form a nest in the earth, and are specially furnished with spines on the falces to excavate the holes for it. It is, it seems to me, most conceivable that spiders should first take advantage of sites already suited for their habitations, and that subsequently the species fitted for forming their own sites should be gradually developed."

Societies and their Work.

ALTHOUGH the season for excursions is almost over, yet several of our local societies have managed to hold well-attended gatherings in the field during the past month, many of which have been fruitful of good results. The Manchester Field Naturalists' Society held an excursion at the Todmorden Valley. Few districts are more privileged in the possession of a prettier system of sylvan walks than are found in Scaite Wood, where the party rested after their afternoon's ramble. Few botanical curiosities were observed on the occasion beyond the bluebell of Scotland (often miscalled "harebell") and the "eyebright" (*euphrasia officinalis*).—Rivington formed the scene of a delightful excursion made by the Scientific Students' Association of the same city. The walk from Horwich to the top of the "Pike" was a gradual ascent, reaching eventually a height of 1,195 feet above the sea. A visit which had been arranged to the Liverpool Corporation Waterworks had to be postponed to another occasion.—The Field Naturalists of Cottonopolis have also made a visit to the Ship Canal excavations, a region of which they seem never to tire, the route selected on this occasion being from Eastham to Ellesmere Port. Mr. William Gee and Mr. Alderman W. H. Bailey each contributed a short paper bearing upon the geological and other scientific features to be observed during the day.—The Geographical Society (still of Manchester) visited the Botanical Gardens at Old Trafford, where the members were entertained with a brief but excellent address by Mr. Leo H. Grindon on the geographical distribution of plants.—The Society of Antiquaries of Lancashire and Cheshire have been attracted to Astbury and Little Moreton, where, under the leadership of Mr. George Esdaile, they investigated that curious old mediæval relic, Moreton Hall, perhaps the most perfectly preserved example of a sixteenth-century "half-timbered" mansion existing in England.

In Yorkshire the work of the societies has proceeded apace. The Yorkshire Naturalists' Union have held a busy meeting at Walton and Kirkham Abbey, being the concluding excursion of the Union for this year.—The Leeds Naturalists' Club and Scientific Association devoted an in-door meeting to a paper by Mr. J. W. Addyman, entitled "Botanical Notes on Norway," which proved an attractive subject, and in the department of out-door work they arranged for an excursion to Filey, with the two-fold object of working the sands and rock pools on the Brigg and of dredging in the Bay.—The Leeds Photographic Society have been considering the proposed Photographic Exhibition to be held this ensuing autumn. It has been decided that the exhibition is to be confined to the works of members, and that no prizes will be offered. Lime-light demonstrations will be made a special feature, and altogether the project has been taken up with a considerable amount of enthusiasm, which must be encouraging to the promoters.—Of the many Abbeys in Yorkshire the ruins of Kirkstall form one of the finest reliques of our ancient ecclesiastical architecture still preserved to us, and, in arranging for a special excursion to this favourite spot, the Field Naturalists' Club of the Leeds Co-operative Society once more evidenced their desire to make their club popular, and to arouse their members to take an intelligent interest in the localities around them.

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Societies.

BRITISH PHARMACEUTICAL CONFERENCE. — The twenty-sixth annual meeting of this Conference was opened on Tuesday, the 10th September, at the College of Science, Newcastle-on-Tyne, under the presidency of Mr. C. Umney, London. The President, in his address, said it was in this very town twenty-six years ago that the British Pharmaceutical Conference had its birth. Since the first Newcastle meeting the rival pharmacopœias of London, Edinburgh, and Dublin had been fused into a national pharmacopœia, and this had been advantageous in helping forward and maintaining uniformity and purity in medicine. The Sale of Food and Drugs Act had materially aided in maintaining and advancing purity in medicine. The working of this Act, in so far as it concerned the drug trade, had not been without friction, due in many cases to the imperfect knowledge of officials; but happily within the past year, on account of the broader views prevailing and the interest taken in the work, and the practical men at the head of the Inland Revenue Department, there had been an amendment, and the Excise regulations, which so trammelled them in the past, had now to some extent been removed, and at last there was an opportunity in the future of guaranteeing that the products of the manufacturing pharmacist were what they professed to be. In his opinion alcohol free of duty for medicinal purposes, or some facility to work with pure alcohol under supervision, was a most serious and urgent necessity. The late president of the chemical section of the British Association referred at the Bath meeting to the decline of chemistry in this country. While he (Mr. Umney) was not in a position to give an opinion on this subject as a whole, he fully concurred in Professor Tilden's views so far as the study of chemistry and its application to the manufacture of substances for use in medicine was concerned. In his opinion two causes at least had brought this about—namely, the stringent regulations with which they had been hemmed in by the Excise, and the meagre opportunities of education and research that had up to a very recent date been afforded in this country. One would imagine that they were all agreed upon the desirability of a good scholastic and scientific education, backed by business training, for those who practise pharmacy. In his opinion no simpler method could be devised in aiding pharmacists as a body to maintain the excellent principles of that association than this thorough training, accompanied by the higher education of some in its ranks in research. Mr. W. A. H. Naylor read a paper on "Chemical Observations on Root-Bark of Euonymus." Speaking on "Arsenic in Glycerine," Mr. Louis Siebold, F.I.C, said that some time ago attention was called to the occasional occurrence of arsenic in glycerine. He had, therefore, examined a considerable number of samples which he had collected. The result of the experiments was that a very large proportion of glycerine—and he was not alluding to the dark-coloured glycerine used for technical purposes, but the colourless and odourless samples used for toilet and medicinal purposes—certainly contained arsenic. He calculated that the quantity of arsenious acid was between one in 4,000 and one in 6,000. In a few instances he found more than that. This simply meant that there was one part of *liquor arsenicus* in 40 parts of glycerine; in other words, if they made a one-ounce mixture containing something like 10 minims of the *liquor arsenicus*, they would have a liquid of the strength and containing as much arsenic as this glycerine. Some of the samples were perfectly free from arsenic. In considering the question, where did the arsenic come from? it had occurred to him that it might arise from the bottles in which it was contained. They knew that glass bottles contained arsenic, and they knew also that glycerine was a powerful solvent of arsenious acid. It was, therefore, possible that this might be the cause of it. Mr. R. Reynolds read a paper on "Negative Evidence of Lead in Drinking Water," which was followed by a paper by Mr. A. H. Allen, F.I.C., F.C.S., public analyst of Sheffield, on "Vermin Killer Containing Strychnine." The author said the fact of certain vermin killers containing strychnine as an active principle recently acquired a particular interest for him in connection with an alleged murder by poisoning. He had obtained from wholesale druggists a number of specimens of vermin killer, representing the chief makers all over the kingdom. There were ten specimens. He had analyses extending back to 1862. In 1862 the strychnine in the vermin killer was 5·8 per cent. of the weight of the powder; in 1876 it was 10·7 per cent. He himself had recently found 11·2 per cent., and as much as 23 per cent. was stated to have been found. He considered such colouring matter as carmine to be objectionable. Pink powders were used for teething, and grey powders were used for medicinal purposes. He would give preference to the green and blue powders rather than to those simply coloured with carmine. They had no food or medicine which was blue in colour, and therefore anything blue in the contents of a stomach suggested something wrong. The preferable colouring matter was the green oxide of chromium. It was perfectly insoluble in water or in any other liquid, and was non-poisonous, owing to its insolubility, and, therefore, chemically inert. It was not destroyed by ignition, and would, therefore, actually be able to be found after cremation. Other papers were submitted to the Conference on the following, amongst other subjects:—"Wild Cherry Bark," by Mr. L. W. Hawkins; "The Medical and Chemical Misconception About Lithia," by Mr. Louis Siebold; "Note on a Scale of Small Residues," by Mr. B. S. Proctor; "Stropanthus Plants," by Mr. T. Christy, F.L.S.; "The Chemistry of Stropanthus," by Professor T. R. Fraser, F.R.S.; Narceine and its Salts," by Mr. D. B. Bott, F.R.S.E.; "Tannin, its Solubilities, &c.," by Mr. B. S. Proctor; "Exact Formulæ for the Official One per Cent. Liquors," by Mr. C. A. Macpherson; "Liquor Morphinæ Meconatis," by Mr. C. A. Macpherson; "The Strength of Commercial Specimens of Scheele's Prussic Acid," by Mr. R. Wright; "The Relative Value of Alcohol and Chloroform and Mixtures of the Two for the Extraction of Aconite and Belladonna Roots," by Mr. R. Wright; "An Impurity on a Commercial Sample of Sodium Salicylate," by Mr. R. Wright; and "Cæsarea Esculenta," by Dr. P. S. Mootooswanny, F.L.S., Tanjore. It was decided to hold the Conference next year at Leeds, and the following officers were elected for the ensuing year:—President, Mr. Umney; local secretary, Mr Branson; general secretaries, Dr. Thresh and Mr. Naylor.

LIVERPOOL NATURALISTS' FIELD CLUB.—On the 22nd of August some thirty members and friends left the Landing Stage and proceeded to Rhydymwyn, and thence pursued a route which lay through the valley called the "Leet," where the river Alyn flows among the limestone rocks; the party followed the course of the river some way, and then ascending the hillside continued their way along a raised pathway formed out of the rock. It was a charming walk, affording many beautiful views of the river and the distant hills. On either hand the sloping banks were bright with flowers, and the botanists were rewarded after their ramble among the wet grass and bushes by many good "finds." *Sambucus ebulus*, dwarf elder, or Danewort; *Malva moschata*, musk mallow; *Atropa belladonna*, deadly nightshade; *Epipactis latifolia*, broad-leaved helleborine; *Scabiosa arvensis*, field Scabious; *origanum vulgare*, marjoram; *Thalictrum flexuosum*, meadow rue; *Geranium pratense*, blue crane's bill; *Geranium sanguineum*, blood crane's bill; *Carduus nutans*, musk thistle; *Serratula tinctoria*, saw wort; *Sedum flexuosum*, reflexed-leaved stone-crop; *Inula conyza*, ploughman's spikenard; and *Asplenium adiantum-nigrum*, were among the best plants collected. The quarries along the way afforded the geologists good opportunities for work. Dinner-tea was provided at the Loggerhead's Inn at Llanferres, after which the prizes were awarded. Order prize for *Umbelliferæ* and *Filices*, Mr. F. Chalmers, with twelve species; best basket of wild flowers, Mrs. E. M. Wood; the botanical enigma (*Inula*

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conyza) was solved, and the plant found by Mrs. Waugh, Mrs. J. Vicars, Rev. S. Gasking, Mr. W. H. Holt, and Mr. R. D. Brown. The party returned to Liverpool from Mold Station by the 7-20 train.——The ninth field meeting of this session was held at Gresford on September 7th. About ninety members and friends left the Landing Stage at 1-40, the day being fine and bright. On arriving at Gresford the party visited Mr. Jarvis's beautiful nursery-gardens, and then continued their walk to Marford Hill, where a fine view was obtained of the surrounding country. Eaton Hall, Saighton Towers, and the Peckforton Hills were seen, and then from the higher ground of the steep mound, known as the "Roft," the lovely panorama of woods and hills, bright in the afternoon sunlight, made up a grand picture, with here and there the russet tints of autumn beginning to show among the foliage. On descending the "Roft" the way lay through the woods by the railway back to Gresford village, where tea was provided. After tea the beautiful old church was inspected, and some of the more adventurous members ascended the tower and looked down upon the country round, over which by that time the mists of evening shadows were creeping. A good amount of botanical work was done, and the most interesting plants found were:—*Astragalus glycyphyllos*, milk vetch; *Verbascum lychnitis*, white mullein; *Campanula trachelium*, nettled-leaved bell-flower; *Malva moschata*, musk mallow; *Inula conyza*, ploughman's spikenard; *hypericum montanum*, St. John's wort, and *Equisetum maximum*, giant horse-tail. The following prizes were awarded:—For naming the greatest number of plants in flower or fruit, Mr. F. R. Chalmers, 79 species; orders for the day, *malvaceæ*, *onagraceæ*, *campanulaceæ*, and *plantaginaceæ*, Mr. J. Vicars, with nine species; for collecting the greatest number of plants in flower or fruit, Miss Unwin, 92 species; for the best wild-flower bouquet, Miss Mackarell; after keen competition Mrs. Adamson being highly commended. The botanical enigma (*Verbascum lychnitis*) was solved, and the plant found by Mrs. Waugh, Mrs. J. Vicars, Mrs. Adamson, Miss E. M. Wood, Miss H. I. Hunter, Miss F. Adams, Rev. S. Gasking, Mr. C. F. Webb, and Mr. J. Vicars.

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Berwickshire Naturalists' Club.—The fifth meeting of the season was held on Wednesday, September 11th, at Beadnell. Mr. Howey Taylor, of Beadnell Hall, kindly entertained the members to lunch. After partaking of his hospitality the house and grounds were inspected. Many objects in the library attracted much attention, particularly his mineralogical specimens. The grounds were next inspected, much interest being taken in a fine specimen of the *Yucca Gloriosa*, which had recently flowered, and had been photographed. Under the leadership of Mr. Taylor the members then visited the National History Museum of the late Dr. Embleton, a most interesting collection. After seeing the old Pele Tower the members made their way to the beach, and inspected the foundation of the old St. Abb's Neuk Chapel. Mr. Taylor had caused a great portion of the foundations to be uncovered, by which a better estimate is formed of the antiquity of the chapel. The old disused lime-kilns studded along the coast were objects of interest, showing the decay of a once prosperous industry. Mr. Taylor imparted much information regarding the geological features of the coast. After a most interesting stroll the members returned to the village and took brakes for North Sunderland, where the new harbour was inspected.

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Manchester Microscopical Society.—The ordinary meeting of this society was held on 5th September, Mr. J. E. Hoyle in the chair. Mr. Aylward presented a set of his new series of educational slides, twenty-four in number, representing stem structure, which had been executed by Mr. A. Flatters. Mr. William Scanley presented twelve slides of mosses and hepatics. Mr. E. Halkyard, F.R.M.S., stated that in a recent visit to Southport he had picked up ten ounces and a half of foraminiferous sand from the ripple marks and edges of the tide pools, and had found forty-one species of Foraminifera, two of which were not recorded in the Liverpool Marine Biological Committee's list, and five were not in the Jersey list. He also found the medusiform gonozooid of the Hydroid Zoophyte, *Obelia gelatinosa*. Mr. James, honorary secretary, reported that Mr. Etchells, a well-known naturalist, had sent down a quantity of *Alcyonella fungosa*, which he had discovered in this district. To some microscopists this is the most beautiful of all the fresh-water polyzoons, and, as the specimen contained a large number of statoblasts, there is every probability that, instead of having to go miles for a specimen, the members will be able to procure it abundantly near home. Mr. George Wilks read a communication from Mr. Wm. Harvey, of Constantinople, on *Hydra Fusca*. Mr. Harvey said that, in watching the hydra, he saw it swallow a large water-flea much larger than itself. This it retained for an hour and afterwards ejected it. It then turned itself completely inside out, and dropped to the bottom of the cell, its "tail disk" being gone. It was watched in this condition for five hours and a half. It was then placed in a tumbler of water, where it remained from 10 p.m. until 10 a.m. next day, when it was found to have taken another meal during the night. The hydra did not re-turn itself to its original position, but has several times turned itself inside out half way, but never entirely. Mr. E. Halkyard gave a *résumé* of his paper on the "Recent *Foraminifera* of Jersey," describing a collection made by him from a dozen localities on the south and east coasts of the island. The collection is the result of three years' work, and comprises 126 species and varieties, two of which are new, whilst seventeen others have not been found in the British seas up to the present time. The entire collection will be on view at the October meeting of the society.——The seventh ramble of the season took place at Stamford Park, whence the members made their way through Hurst to some ponds near Lees. One of the most interesting botanical specimens noticed was the *Aralia spinosa* in full bloom, whilst the fine collection of Alpine plants and their beautiful arrangement were much admired. In the hot-houses several kinds of pollen were secured by the members, and a large leaf with beautiful stellate hairs and peculiar sharp spines issuing from every portion of the fibro-vascular bundles was eagerly sought after. Specimens of the blue gum tree, *Eucalyptus globulus*, were also obtained. Some fine specimens of a species of *Begonia* served to illustrate a class of plants known as *monœcious*, that is, plants which have female or pistillate and male or staminate flowers on the same plant—in this case on the same stem. Passing through the park to the large pond the Canadian pond weed was found in full flower. Passing through the village of Hurst a halt was made at a group of pits, where was found attached to pieces of decaying wood a very scarce algæ, *Pithophora Kewensis*, in fruit. Its primary branch is shortly jointed with single spore cells (Hypnospores) of a conical shape and each one terminal. Several other scarce algæ and desmids were found. Farther on the yellow water lily, *Nuphar lutea*, was discovered in abundance, but only one or two flowers were seen. During the afternoon the members had a good example of the jealous care of rare or scarce specimens which is taken by the true naturalist. The leaders pointed out a small plant of the wall rue spleenwort, *Asplenium ruta marina*, and, although its existence must be known to a large number of botanists, it had remained there untouched for more than twenty years.

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Huddersfield Technical School.—The fourth party this season was ably conducted by Mr. Edwd. Brooke, J.P., to Retford. The weather being everything that could be desired helped to bring out more distinctly the various contours of the more marked physical features caused by the carboniferous, permian, and triassic formations, which were seen by the party to great advantage. The magnesian limestone which overlies the coal measures, and gives a scarped edge chiefly

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exposed in a long narrow band on the east side of the Yorkshire coal-fields, was well exposed in the various quarries near the line of railway between Red Hill and Harry Croft. Next above this limestone, which was passed over, come the marls and sandstone which divides the upper from the lower magnesian limestone. The route did not bring the party in contact with this upper portion, but over the next above, called the lower red and mottled sandstone. After that came the pebble beds or conglomerate, which crops out near Worksop station and continues to Retford. The party now drove through the pretty little town of Retford to a brickyard, not far from Gainsborough Road, where the Keuper waterstones were examined. The lower division of these consists of red and grey sandy marls with bands of sandstone varying in texture from coarse pebbly grit to fine, close-grained freestone, and in colour from brick-red to blue, green, or white. The hardness also varies from compact tough rock to barely consolidated sand. The chief interest of these beds lies in the abundant supply of water which they contain. At the Scarle boring one feeder from these beds rose in pipes 52 feet 4 inches above the surface, or about 100 feet above sea level. A short distance below the above brickyard Mr. Brooke pointed out where the Retford Coal Company had bored 14 feet into the coal measures, the bore hole giving the following sections:—Keuper 42ft., bunter pebble beds 451½ft., lower bunter 292½ft., permian 106ft., giving a total of 906ft. This boring was not very satisfactory, as it could not be determined which part of the coal measures the 14ft. of shale belonged to, so for the present it is abandoned. The party next drove to the small village of Clarborough, where they visited a field which had formerly been worked for gypsum. This was the most interesting section seen during the day; all the gypsum bands, ranging from half an inch to five or six inches in thickness, were very clearly defined. They were interstratified with the marls. This zone is near the bottom of the marls and occurs in horizontal and oblique veins, the inosculations of which bind the mass of marl which they penetrate into a species of rock. The fibres of the gypsum are invariably vertical, and, therefore, inclined at all angles to the faces of the marl which the veins separate. The thickness of the Keuper marls is about 690 feet, including the grey marls at the top. The party then visited a quarry at South Wheatley, which had been worked for fifty years by Mr. Richard Cook, and proceeded to Bolham Mill Lane, north-west of the town of Retford, where they examined another fine section of the pebble beds, which were well exposed and very interesting.

Reviews.

Reports of Societies, &c.

Proceedings of the Association of Public Sanitary Inspectors of Great Britain (N. W. District).—Vol. ii., 1888-9.—Although the association bearing the above title has only been a couple of years in existence yet it has succeeded in accomplishing some useful objects. The discussions arising from papers read at the meetings, as well as the practical knowledge acquired by visits of inspection to important sanitary works, have demonstrated that its functions will be of value to the community by increasing the knowledge and enlarging the experience of those engaged in the work of the sanitary inspector. The president of the association is Dr. Alfred Carpenter, and the vice-president Dr. J. Stopford Taylor, Medical Officer of Health, Liverpool. The papers printed in this volume are:—The President's Address, by Dr. Carpenter; "Other Plans Than Ours," by H. D. Mathias; "The Essentials of House Sanitation," by J. Davidson, M.B.; "The Disposal of House Refuse," by Arthur Salmon; "Sanitary Work in Rural Districts," by W. Bland, M.S.E.; "Some Comments on the Public Health Act, 1875," by W. W. Marks; and "Sanitary Work: Is it Beneficial to the Ratepayers?" by A. Stansfield. All of these subjects, it will be seen, are of the practical order, and therefore are likely to be eminently serviceable to those to whom they are addressed.

Birkenhead Literary and Scientific Society.—Report, 1888-9.—This society has now reached the end of its 32nd session, and continues an active career. In addition to the various meetings for the reading and discussion of papers, the society maintains a subscription library of over 3,000 volumes. Among the scientific subjects treated of by members during the last session, we note papers on "Darwin and the Origin of species," by John Ziegler; "The Relation of Mind and Brain," by Theobald Palm; "Flight, Natural and Artificial," by W. P. Thompson; "The Study of Languages as a Branch of Applied Science," by Wm. Gow, M.A., Ph.D.

Journal and Annual Report of the City of London College Society.—1888-9.—In the report for their fourth session, the committee of this society are enabled to announce a further increase in the membership, and to present a substantial list of papers read and work done. Quite a large number of excursions have been held—a feature which has proved very attractive. The society publishes a monthly journal, the number for June being devoted entirely to an excellent paper by Mr. W. Boutall, on "Recent Advances in connection with Methods of Photographic Reproduction."

Transactions of the Historic Society of Lancashire and Cheshire.—N.S. Vol. iii. 1887.—The production of another volume of "Transactions" within a few months, is a sufficient indication that the reputation of this old-established society is fully maintained by those now at the head of its management. The papers printed are as follows:—"Foreign Quarterings in Lancashire Shields," by Rev. A. E. P. Gray; "Windleshaw Chantry," by Rev. A. Powell; "The Domesday Record of the Land between Ribble and Mersey," by Rev. A. E. P. Gray; "Recent Roman Discoveries in Lancashire and Cheshire," by the late W. Thompson Watkin; "The Descent of the Masceys of Rixton," by Mrs Arthur Cecil Tempest; and "Selections from Ancient Papers of the Moore Family." These are all of considerable historical and archæological interest, and are illustrated with the necessary plates. The autotype reproduction of Windleshaw Tower in the old Cemetery, forming a frontispiece, is very fine. The Moore charters (dating from the 13th century) are, perhaps, the most valuable collection of ancient documents ever seen in Liverpool. They are being transcribed and prepared for publication by Mr. T. N. Morton, under the auspices of the society and of the Corporation of Liverpool.

Transactions of the Manchester Microscopical Society.—1888.—An "ink-photo" portrait of Mr. John Boyd, past president of the society, forms the frontispiece to the newly issued volume of "Transactions." The report shows an increase in the number of members, and a satisfactory amount of work done during the session. Several interesting papers are printed more or less fully, and the volume is embellished with some well-drawn plates illustrative of the various papers. The president's address is by Professor A. Milnes Marshall, and deals with the subject of "Inheritance." To many readers, the most attractive feature of the present publication will be the discourse, by Professor W. Stirling, on "Electrical Phenomena in Animals," and amongst other papers which will repay perusal are "Pepper Trees," by Jas. Hart; "Meteorites," by P. F. Kendal; "Trap-door Spiders," by R. Parkes; "A Vegetable Trap," by E. P. Quinn; and "The Microscopic Examination of Food for Adulteration," by A. W. Duncan. Reports of field excursions and rambles are also given. During the session a course of "demonstration lectures" on Histology was undertaken with some success, under the direction of Mr. E. P. Quinn, the subject of the session's work being the "Structure, Chemistry, and Physics of the Vegetable and Animal Cell."

Magazines and Serials.

The Photographer's World.—Percy Lund & Co., Bradford. Monthly, 15th.—The number of journals devoted to photography is now very large, but the above-named journal contains features not common to all of them. It is designed "for the profession only," and is supplied gratis to every photographer, dealer, and photographic society in the British isles. The contents will be found to be of a useful character to all who are practically interested in photography and its attendant processes.

The Optical Magic Lantern Journal and Photographic Enlarger.—Taylor Brothers, London. Monthly, 15th.—This is a new venture, and is described as a "magazine of popular science for the lecture room and the

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domestic circle." The lantern is now so much used for scientific demonstration and for educational purposes that there is, no doubt, scope for a periodical devoted to matters, technical and otherwise, connected with this instrument. Articles are given on the construction and illumination of lanterns and their accessories, besides miscellaneous notes. The only fault we have to find with this journal is its title. Surely it is time that the word "magic" should be dropped in reference to the optical lantern.

The Lyceum.—Kealing & Co, Dublin. Monthly.—This excellently-produced journal is not so widely known on this side of the British islands as it deserves. It affords a monthly review of literature and education. The articles are of a high-class character and will repay perusal.

The Brewer's Journal.—F. W. Lyon, London.—This old-established trade journal continues to maintain its reputation. In addition to a large amount of intelligence on topics interesting to brewers and chemists commercial news, and answers to correspondents' inquiries (which is made a special feature), the journal contains valuable papers and articles, of which we may note the following in recent issues:—"Starch and Diatase," by Dr. C. J. Lintner (an address delivered at the Brewers' Congress at Stuttgart); "Sources of Infection in Breweries," by Dr. P. Lindner; and "Brewery Management," by C. Howard Tripp.

The Wesley Naturalist.—July-August, 1889.—The numbers of this periodical to hand bear evidence of the good exercised by the Wesley Scientific Society. Amongst the contents we note—"The Cockroach," by T. D. Wright; "Dredging Off Puffin Island," by E. Swainson; "Our British Wild Flowers" *(Primulaceæ)*, by F. T. Law; "High Power Objectives," by E. C. Bousfield; and "Sea Lilies," by the Rev. W. Spiers. We regret to notice an announcement that the "anticipations in regard to the number of subscribers have not been realised," and in order to avoid a deficit on the year's work the society have decided to publish the journal quarterly in future instead of monthly. The quantity of matter in each issue will, however, be increased, so that subscribers will not lose by the change.

Life-Lore.—W. Mawer, London. Monthly, 4d.—Although the price of this monthly periodical has been reduced there is no diminution either in the quantity of matter, quality of its contents, or excellence of its illustrations. Mr. C. M. Smith, of Bristol, contributes to recent issues a thoughtful paper on "The Phases of Life;" Professor Herdman continues his account of the biological cruises of the *Hyæna*, and gives illustrations of the new submarine tow-net fitted with an electric lamp. The department for the "Young Naturalist" is made attractive each month, the papers being well illustrated, printed in large type, and compiled in simple yet forcible language.

The Naturalist.—July-Sept., 1889. Edited by W. Denison Roebuck.—Accounts of the Yorkshire Naturalists' Union meeting at Holmfirth, Robin Hood's Bay and Harrogate, "Notes on North of England Rocks," by Mr. Alfred Harker, "Fungi," by Walter Strickland, "The Birds of Newcastle-on-Tyne Moor," by R. Dunbar, "Observations at Anton Stones," by S. L. Mosley, and "Radiated Varieties in the Genus Arctia, &c.," by G. T. Porritt, form the principal contents of these two numbers. One of the most useful features of this journal—and one which fulfils a distinct function in North of England periodical literature—is the publication of bibliographical lists on natural history, which are simply invaluable to students of one or other of the branches of knowledge to which they refer.

Letters to the Editor.

SPREADERS OF DISEASE.

SIR,—I was much interested by Mr. J. W. Slater's article on "Diptera, as Spreaders of Disease," in the July number of *Research*. It so fully accords with my own ideas that I felt I could not refrain from having one word on the subject. How old is the theory that flies spread diseases? There is such an appropriation of English ideas by continental writers that I would thank any reader for information that might help one to learn. I feel confident they are not the originators of the theory that diptera spread diseases.

In October, 1872, I wrote an essay on "How Diseases are Propagated," which I read before an improvement society in the town of Crewe, and again before a large gathering, so much was the interest in it, at its annual meeting on November 6th in the same year. How the interest has grown in such matters since then! From mere observation I suspected flies; my first apparent confirmation came from the sad havoc, in the shape of three carbuncle-like swellings, which a fly had made on the back of the hand of a young lady whilst sketching in Fairy Glen, Bettws-y-Coed, when I was there in July, 1871. The theory running through my paper was that such effects could not be produced by the mere introduction of the lancet of a fly, unless accompanied by some poisonous matter. Of the likelihood of flies to gather such matter in sick chambers, sewers, dung-heaps, &c., none ever question. The Tsetse fly was described, the often deadly effect of its bite and the supposition of the presence of some poisonous matter on its proboscis discussed; I believe to-day it is acknowledged that its power is due more to poisonous infection of the wounds than to mere piercings. The discovery by Dr. Manson that mosquitoes convey *Filaria sanguinis*, which give rise to a sort of leprosy *(Elephantiasis)* in India, is a singular illustration of how roundabout a course such a poison may take before showing itself.

One line only from my old almost forgotten paper I will quote: it seems suitable just here:—"Suppose some fly were to come from a quantity of infectious matter and alight on your hand, is it not highly probable, if it were to insert its lancet, loaded necessarily with infectious filth, and that filth came in contact with a capilliary, would you, or would you not, be liable to be inoculated by this insect of a disease as deadly as the matter it had just come from?" With later knowledge what a text this would make! We know now that propagated diseases are often intensified when so transmitted—how terribly so in cultivations of bad blood—and whether diseases are due to disease-grafts or germs, so called, no better carriers than the ubiquitous diptera could be found.

HENRY CROWTHER.

The Museum, Truro,
August 30th, 1889.

MR. E. H. RUNDLE, Tavistock Road, Callington, E. Cornwall, writes that he has noticed in some samples of decorticated cotton-seed cake, after they have been stored for a short time, a fine powder collected around the bag, and that the colour has become changed from bright yellow to a deeper tint. On this being more closely examined he has found to be a mass of living matter, composed of minute organisms, some spherical, others more elongated, in size about 0·0001 of an inch. He askes: "Have any of your readers noticed similar appearances in cotton-seed cake? and, if so, what are these minute forms of life, and whence is it supposed they originate?"

[Mr. Rundle mentions what is certainly unusual, and it would be interesting to know conditions of transit, storage, &c., as well as special characters of the cake itself.—ED. *Research.*]

Obituary.

We regret to learn the death at Darlington, on 3rd September, of Mr. J. T. ABBOTT, a well known antiquarian and collector. He made many valuable literary contributions, bearing on old manners and customs. He possessed a great talent for and knowledge of heraldry. The seal for the North Eastern County School at Barnard Castle was designed by him.

Publications Received.

A Contribution to the Flora of Derbyshire, by Rev. W. H. Painter (G. Bell & Sons); *Lessons in Elementary Physiographic Astronomy*, by John Mills (Chapman & Hall); *The Middle Lias of Northamptonshire*, by Beeley Thompson, F.G.S., F.C.S. (Simkin, Marshall & Co.); *Solutions to Questions set at the May Examinations of the Science and Art Department:—Principles of Agriculture, 1881-6*, by Dr. Henry J. Webb, B.Sc., &c.; *Magnetism and Electricity, 1881-6*, by W. Hibbert, F.I.C., A.I.E.E.; *Hygiene, 1884-6*, by Dr. J. H. E. Brock (Assist. Exam. in Hygiene); *Animal Physiology, 1881-6*, by Dr. J. H. E. Brock (Assist. Exam. in Hygiene); *Building Construction, 1881-6*, by Henry Adams, M.I.C.E. (Chapman & Hall); *Annual Report and Proceedings of the Liverpool Science Students' Association, 1888-9; Descriptive Catalogue of Paintings, &c., of the Royal Free Museum, Salford*, 12th Edition; *Exhibition of Photographs, June, July and August, in Royal Free Museum, Salford; Syllabus of the Manchester Technical School, 1889-90; Syllabus of Engineering Subjects, University College, Liverpool; Birmingham Exhibition Supplement, August, 1889; Life Lore*, September; *The Naturalists' Gazette*, September; *The Western Magazine and Portfolio*, September; *Knowledge*, September; *The Naturalist*, September; *Brewers' Journal*, September; *The Optical Magic Lantern Journal and Photographic Enlarger*, September; *Report of Mansion House Meeting* re *Pasteur Institute, &c., &c.*

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NOTICES.

☞ **We shall recommence next month our series of Portraits and Biographical Sketches, which we are again compelled to hold over owing to the very large number of other communications in type.**

Cases for Binding Vol. I., Price 2/-, or by post 2/3, may be obtained on application to Mr. E. O. Windel, 9, Hackin's Hey, Liverpool.

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Remittances and Communications respecting Advertisements, should be addressed to C. BIRCHALL, 32, Castle Street, Liverpool.

Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the followlng numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

The Life-Zones of the British Lias.

BY H. E. QUILTER.

THE original tripartite division of the Lias formation into Lower, Middle, and Upper beds is of some importance, as it can be recognised both from physical and palæontological points of view wherever the Lias is well developed, and is therefore the true reading. Latterly these divisions have been supplemented by their sub-division into Life-Zones.

Within the beds of the Lias formation, which are essentially argillaceous and homogeneous, certain horizons can be recognised as containing a certain number of fossil species not found either above or below that horizon. Associated with these, a particular species of Ammonite appears to attain its maximum development; from which the zone is named. As an instance, the lowest beds of the Lower Lias are characterised by the abundance of *Ægoceras (Ammonites) planorbe*, together with a special molluscan fauna; these beds are termed the "Zone of Ammonites planorbis." It should be remarked that in no case is there any line of demarcation between the various zones, nor is the Ammonite, from which it derives its name, strictly confined to that particular horizon. These zones are extremely constant, and are recognisable wherever the beds are developed to any extent. We are enabled by means of these zones to divide the beds into special horizons, which, moreover, have no stratigraphical existence. They are, however, of the greatest palæontological importance, and are readily available when working out the stratigraphy of the formation in any district.

Although this zonary classification is constant over wide areas, precisely the same assemblage of species does not characterise them everywhere. Many of the highly abundant species, and consequently the most characteristic forms of one locality may become rare, in some cases entirely disappearing, while in another locality they are replaced by others. In some districts also, other zones may be intercalated; these may possibly be due to an alteration in the conditions of the deposition of the beds in which the fauna is contained.

While considering this, it should be remembered that species of mollusca vary considerably in their range, some being limited to small areas, while others are more widely diffused. The geographical distribution of the modern mollusca shews that some species characterise particular regions; they may require peculiar surroundings or possess small means of migration. On the other hand other species may possess great facilities for diffusion, and more easily adapt themselves to an altered environment. In these specific areas there is frequently a smaller area where the species is more abundant than elsewhere. There is good reason to believe that these same circumstances occurred in the Liassic seas as in modern times.

H. B. Woodward, F.G.S.[1], gives the following table shewing the geographical distribution of the zones :—

1 Geology of England and Wales—2nd Ed.

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TABLE SHEWING THE GEOGRAPHICAL DISTRIBUTION OF THE AMMONITE ZONES IN THE LIAS OF ENGLAND.

DORSETSHIRE.	SOMERSETSHIRE.	GLOUCESTERSHIRE.	MIDLAND COUNTIES.	LINCOLNSHIRE.	YORKSHIRE.
communis	communis	communis	communis	communis	communis
..	..	..	serpentinus	serpentinus	serpentinus
..	..	..	..	..	annulatus
spinatus	spinatus	spinatus	spinatus	spinatus	spinatus
margaritatus	margaritatus	margaritatus	margaritatus	margaritatus	margaritatus
..	..	capricornus	capricornus	capricornus	capricornus
Henleyi	..	..	Henleyi	..	..
..	..	ibex	ibex	..	..
..	Jamesoni	Jamesoni	Jamesoni	Jamesoni	Jamesoni
..	armatus	..	armatus	armatus	armatus
raricostatus	raricostatus	raricostatus	..	..	..
oxynotus	oxynotus	oxynotus	oxynotus	oxynotus	oxynotus
obtusus	obtusus	obtusus	..	..	..
..	..	..	semicostatus	semicostatus	..
Turneri	Turneri	Turneri	..	..	..
Bucklandi	Bucklandi	Bucklandi	Bucklandi	Bucklandi	Bucklandi
..	angulatus	angulatus	angulatus	angulatus	angulatus
planorbis	planorbis	planorbis	planorbis	planorbis	planorbis

It will be noted in the foregoing list that in some districts various zones appear to be absent, as in Yorkshire, where the zones of A. raricostatus, and A. obtusus are omitted from the list. This is not really due to their non-development, but because MM. Tate and Blake[2], although the ammonites are present, do not find sufficient palæontological reasons for their separation. In the Midland Counties and Lincolnshire, the A. semicostatus zone is developed, which does not appear elsewhere; a local bed of ferruginous limestone, in which A. semicostatus occurs abundantly, being thus named.

While these life-zones of the Lias are confessedly of great importance, no correct explanation of their occurrence has yet been brought forward. J. W. Judd, F.G.S., writing upon these zones, remarks[3]:—"The facies of a zone is dependent upon conditions of deposition; and, further, every fauna is the resultant of three sets of causes, namely, geological age, condition of sea-bottom (such as depth, temperature, nature of sediment, etc.), and geographical position." H. A. Nicholson[4] writes as follows on this subject:—"The principal difficulty that we have to confront in dealing with these zones is to produce any plausible explanation accounting for the destruction of the special life-forms of the one zone, and the appearance of those of the next zone. For the most part, these zones are of very limited vertical extent, and they succeed each other in such a manner as to totally preclude the idea that the dying out of the old forms can have been in any way caused by any physical disturbance of the area. Perhaps the most probable view is, meanwhile, that the formations in which distinct and limited life-zones can be recognised were deposited with extreme slowness, whereas those which show an essential compact and heterogenous fauna from base to summit were deposited with extreme rapidity. Upon this view, a formation like the Lias is one formed by a process very slow and intermittent sedimentation, the life-zones being separated by intervals, during which sedimentation must have been at a standstill, but which were long enough to allow of more or less considerable biological changes, some forms dying out or becoming modified, while other new ones came in."

MM. Tate and Blake, in their work on the Yorkshire Lias, discussing these zones, ask:—"What is their cause? This we cannot answer. We can only say that since there is no observable difference in the mineral character of a part containing a certain ammonite from that of a part a few feet, nay, a few inches, to which another is restricted, the change of life form is not due to the surrounding physical agencies that are observable, but to some others which have left no indication of their action. They were causes, too, which acted *in spite* of the character of the sea-bottom, the change in life-form being very little affected, in the more remarkable instances, by the change or otherwise of the matrix. *Ammonites planorbis* in the limestone may be followed by *A. angulatus* in the clay, or *vice-versâ*. The change, too, is sudden, the Arietan Ammonites come in in a shoal, certainly not modified or developed from others previously existing on the spot; but whence they came, and how they came to be again and again supplanted are among the unsolved questions to which time alone can give us the answer. The change also is more rapid in proportion to the complexity of the organisation—the Cephalopoda which stand high, being much more restricted than the lower forms, the Lamellibranchs often having a wide range."

The slow and intermittent sedimentation assumed by H. A. Nicholson does not appear to represent the physical conditions under which the Lias formation was deposited. The intimate structure of the beds would rather point to a slow but very regular sedimentation or deposition. That the life-zones are not separated by intervals is proved by the fact that the faunas of the zones pass insensibly one into another.

The answer given by MM. Tate and Blake to their own question is certainly a confession of ignorance. As they remark, "the change of life-form is not due to the surrounding physical agencies that are observable, but to some others that have left no indication of their action." As any physical agencies would most assuredly leave some traces of their action, an explanation should be sought for in the biology of the zones themselves.

The migration of molluscan life from other centres into the Liassic seas of the British district, appears to have proceeded slowly, as it is not until a rather high horizon in the beds is reached that all classes of the mollusca are present, or become at all numerous. The lower beds have a restricted generic and specific fauna.

The explanation of the occurrence of the Life-zones of the Lias I am about to offer, is one that may be termed "The successive modification of the faunas." That each "zonal fauna" is developed from the preceding one (with the exception of A. planorbis zone) by modifications of a great part of the species, is, to my mind, a fact. The higher forms of the mollusca, as the Cephalopoda and Gasteropoda, by reason of the greater complexity of their organisation, have also the power of a greater modifiability than the lower forms. This will partly, if not wholly, explain the abundance of the species and genera of the Ammonitidæ. While the higher forms were undergoing the modifications entitling them to be termed "species," the lower forms would also, though perhaps in a smaller degree, be developing new external shell characters.

The slowness of the deposition of sediment in the Liassic seas would be favourable to this very gradual development of new shell characters by the molluscan fauna. As these conditions would be proceeding together, we have an explanation of the passage faunas, commented on by MM. Tate and Blake.

The character of the sediment deposited does not appear to have had so great an influence upon the faunas as would have been anticipated. Even where the beds differ in lithological composition in widely separated localities, the "facies" of the zonal fauna remains the same. There may be some differences, but upon the whole they are not clearly marked, or such that might be attributed to difference in lithological character of the beds.

It may possibly be remarked that this argument is only an explanation of the occurence of the biological zones of the British Lias formation, and we may enquire again—What is their cause? It has been shewn they are due in a great measure to the successive modification of the zonal faunas; but what was the modificative agency?

In the present state of our knowledge concerning biological evolution, we are led to seek for some cause, or causes, or agencies by which the evolution of the organism is brought about. Professor Martin Duncan once remarked[5]:—Is there not some positive energy in living things, which, if uncontrolled and uninfluenced by externals, will produce progressive changes?

[2] Yorkshire Lias.
Geol. of Rutland, &c., Mem. Geol. Survey. 1875. p.49.
[4] Manual of Palæontology. 1879.
[5] Quart. Journ. Geol. Soc. Ann. Add. 1877.

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This question appears to offer a solution to the problem. The slow deposition of the sediment (indeed, the organisms themselves contributed greatly towards the amount of sediment deposited) would not exert any apparent influence upon the molluscan life present in the waters. The great length of time required, under these circumstances, for a deposit of any thickness to accumulate at the bottom of the sea, would also allow a corresponding length of time for biological modifications. Both those conditions, in which the organisms are "uncontrolled and uninfluenced by externals," and time, were probably important factors as modificative agencies. Given, then, these conditions, we have the cause of the successive modification of the organisms constituting the faunas as a possible explanation of the occurence of life zones in our British Lias formation.

The Higher Education of Girls.

By Margaret E. Noble.

FRENCH enough to call a lover a "beau;" music enough to play a dance tune on the parlour piano; artistic training sufficient for the modelling of some more or less hideous wax flowers; a smattering of a few things and a knowledge of none; such was the general education of women of the middle classes fifty or sixty years ago.

And as we stand to-day, and look back upon the progress made since then, we cannot find that the difference is one for overmuch boasting. Then, a woman's mind, in respect of knowledge, was a spirit in prison without hard labour; to-day the treadmill is added, but we fear that she is still in prison. In either case she is equally shut out from the wide and breezy common-lands and the grander-visioned mountain-heights of Truth.

True, Newnham and Girton have become glorious facts; but Newnham and Girton are not the measure of the ordinary education of ordinary girls in this country at the present time; that, it is needless to say, lies in the hands of English High Schools, the main feature in whose system is the Local Examination, which forms the great incentive and standard of the school year, and turns the work of teachers and pupils alike into what is technically termed "cram." Too often it is not true "education" that is carried on in the thorough-going High School any more than that is true agriculture which produces vegetables of the largest size and poorest quality. Suppose we look at such a school and its year's work, premising that its competition is restricted to, let us say, the Cambridge and College of Preceptors' Locals. Very well. The latter examination takes place twice a year, and is usually followed a week later, at Christmas, by the Cambridge. Thus, in some schools, the same girls will pass through three —and often more—examinations in the year. It must be remembered that each syllabus involves a good deal of special work; that each means as much plodding at facts and details as can well be got into the limits of the allotted time; that during this period the girls' efforts are all bent on the object of "passing," and before it on that of "going in;" and it will be clear that too great profundity in any one branch becomes a sin in the student, while her standard of excellence is sure to be degraded into what "will get me through," rather than deepened into the true thirst after Perfection. And thus the means becomes the end. There is no time for thought and reasoning in such a process as this; the zoophyte has certain statements thrown at it, and must assimilate them as best it can. There is no room for intelligent comprehension, much less for any love of truth and learning for their own sakes. The mind is entirely dependent on the examination; take the prop away and the pupil collapses, because "there is nothing left to work for."

Out of one hundred girls taken at random from the *upper classes* (for we fear that these often flourish at the expense of the lower) of any "good" High Schools in the country, while ninety-nine might (if it happened to touch the year's syllabus) be able to give the precise number of degrees' error made by the earlier French *savants* in measuring the earth, we doubt if one would be capable of inferring that such dimensions would compare our planet to a lemon rather than an orange, while we are very sure that not two in a thousand could appreciate the glorious devotion of the great Mechain, who died of a broken heart because he had made that mistake of 3' in a geographical calculation.

And as with science so with art. The rich, throbbing life of the eye and ear is unknown to these "Higher Education" damsels. Ruskin says—"The main thing which we ought to teach our youth is to *see* something—all that the eyes which God has given them are capable of seeing. As a matter of fact, all that we do teach them is to say something;" and it is only too true. The wonderful cry of Beauty is unheard by them; the "wayside sacrament" untasted; they are blind to the thrill of inspiration that the prisoned light of an agate, or the sleeping life of a sculpture, can send bounding into the soul through every pore; and the "Moonlight Sonata" and the "Lieder Ohne Wörte" too often are to them only elaborate five-finger exercises, since they are never taught in them to reach after the soul-yearnings of genius—of the giant children of the universe. There would be "no time" for such dallying over work, as it would seem, doubtless, in the eyes of authority. Aye, true enough! "no time!" "No time" for England's girls to be allowed to *grow!!*

Of course, under the cram-system, besides the danger of allowing all work to be devoted to a few, there must be a sharp distinction between school-time and leisure, and she who would breathe the names of Darwin, Huxley, Handel, Giotto, Shakspere, outside a class-room door must necessarily be stigmatised as "talking shop."

After such a school course, we ask if it is possible that there should have come into the woman's life any of the real beatitude of knowledge, any of the passionate love and longing of the Truth-search, any of the earnestness of high aims and noble motives? We fear not. It seems the rule —when she has not to earn her bread by cramming others as she was once crammed herself—that the girl should rest on her oars when her school years are over, well content to have done so much, careless of reaching any further.

It may be objected that we all know High School girls of real intelligence, as well as book-learning. There are exceptions to every rule. What we maintain is that it is not the tendency of the present system to produce such girls, and we think that when they are found they are usually those who live in refined homes, and have contrived to "scramble up"—for the bitter words of the writer of "Daniel Deronda" still hold good—in spite of their school-training, not because of it.

In the face of all this, what we really do need is *more sympathetic* teaching: more education, less instruction; more leading out, less forcing on. To this end, we must do away, except as concerns teachers, with the examination system; we must take more time; do less more thoroughly; above all, waken more interest, more genuine love of the abstract, in the minds of those who learn. Doubtless, however, our readers think it is easy to carp at the work of others: we have still to prove that our conception is better. Suppose, then, by all that's dreamable, that we ourselves had a school put into our hands, complete, as far as house, school furniture, and children go, our record blank, our great influence untouched: how would we proceed to work out our ideal?

To begin each week we would gather in our flock, large and small, teachers and taught, and tell them—a story! For one hour we would talk, in the simplest words that we could find, of the world-saints of all time—of Buddha, Socrates, Aristotle, Hypatia, Francis of Assissi, Dante, Galileo, Leibnitz, Beethoven, Froëbel, of all great souls, indeed, who have woven into the web of their daily lives the woof of some grand purpose, which has transformed their work into world-treasures; or who, looking on men have read "Mankind," and by their high consecration to the service of Humanity have illumined their personalities with all the crimson glories of self-sacrifice. Always we would strive to show the dignity that may be shed on a common lot, if it be but the shrine of Purity and Honour. So we would aspire to pitch the daily round of our school-life in the loftier, sweeter keys of the world-workers; listening to catch their inner secrets; as free from small jealousies and vanities as Raphael and Fra Bartolommeo; too intent on the highest things to pursue the small frivolities which make up the sum of so many girlish lives. And one other hour in the week we would give to nothing better than a gossip—a science-gossip—when we would revel in Nature's fairy-stories, in the chimes of the hare-bells, and the elfin-rings of the mushrooms, in the revelations of a duck-pond, and the philosophies of stars, in anything and everything, from rainbows to earth-worms. *But*, we would make it interesting. We would tell *how* Columbus came to suspect lands beyond the ocean; *how* astrology grew into astronomy;

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and alchemy into chemistry. We would fill our lessons with the thread of human story, and strive in our pupils to develope into its higher forms the strange passion of the mind for the observation of other life.

And the tone thus given should be carried all through. In teaching geography we would strive to make it picturesque; in history, to show the broad principles at issue from the conquests of Semiramis and the Civilisations of Egypt and China, down to the political economy of Free Trade, and the modern history of France. In teaching mathematics we would strive to show that the exact sciences lay at the root of Michael Angelo's painting and Bach's chromatics, besides forming the backbone of astronomy, chemistry, and commonsense. In grammatical analysis we would aim at teaching by logical induction, and we would instruct our pupils in the histories, as well as the relationships of the words they used.

They should learn modern languages, of course. No education is complete without a knowledge of French and German; but we would teach them the language ere we troubled them with the grammar, and we would divorce neither from its literature. And if, in our course, we happened to work at some play of Molière's, we would not take it up without attempting to give some notion of the whole of which that dramatist formed a part.

One of the defects of the present system is that it keeps children so exclusively at work in one corner of a subject that their ideas get out of proportion; studying Shakspere and Milton and ignoring Chaucer and Spenser, they are allowed to think and speak of "English Literature."

Music should be taught—practically, theoretically, and (above all) historically. But such work should be done in the spirit of true reverence—in the desire to make the soul lie still before the oracle, and let the harp-strings of emotion tremble under the breath of God.

Drawing and the principles of ornament must be studied; but our pupils' practice of the conventional should be accompanied by the imitation of Nature, and while they should be shown the beauties of scrolls, and vases, and gargoyles, and capitals, they should not be left blind to the deep, quivering glory of a leaf, or a naked branch, or a summer mountain, or a glowing branch of autumn berries.

And with and above all this we would teach some physical and some biological science. No one of these can be kept quite distinct from the others; in teaching one is given the key to all. The great thing is to picture vividly the problem that has to be faced, and then proceed to elucidate it. We have won our knowledge largely by induction; it is well sometimes to reverse the process and impart it by deduction. The mere conception of our earth spinning in one swift, continuous rush on her tremendous path around the sun, is enough to waken a fund of interest and wonder that will be a grand spur. And in the same way biology, being taught with due regard to its philosophy, ought to be at once a poem and a parable. There is one agent of elevation, which we believe superior gold to the study of biography, yet to be mentioned.

Girls, we hold, *ought to be brought into constant social contact with minds of knowledge and intelligence higher than their own.* Even the society of their teachers ought to be a great educator. But we would go a step further and do all that we could to surround at least the elder of our girls with the atmosphere of intellectual distinction by letting them meet with men and women of ripened powers and wide experience. Only those who have seen it can imagine the beneficial influence which this will exert. Thus, our ideal education would be an education of the drawing-room and the art gallery, the tea table and the concert, as much as of the school and class-room. It would not, we believe, take longer than the curriculum already in vogue, neither do we think that its effect need be to leave a romantic haze about things in general, and a definite knowledge of none. We have not enumerated the details of our work, but simply indicated its principles. We would let the child catch a glimpse of the forest sometimes, but we would not ask it to forget the existence of the trees. We would not exclude facts because we sought laws—quite the reverse. But while we gave some work to the memory we would give some, also, to the *consciousness*, trusting to the faculties of realisation much that would be useless if only remembered. We would not ignore what the cram-books say, but neither would we, for them, ignore the world's great books. Striving by all wise and gentle methods to make some of our English girls *cultured gentlewomen*,

There is, in fairness, a word to be said on the other side. The system at present in vogue has taught us many things which we had need to recognise. It has raised a high standard possible of attainment for women. It is the foothold which makes technical advance possible. It has almost abolished "extras" from school prospectuses. It has been the reaction against disgraceful torpor. In these respects it has, for the woman-subjects of England's woman-ruler, been the glory of this century.

But all reaction is apt to be extreme. It would be well, then, that all of us who have some responsibility in the training of the women of the future should bear this in mind, and, by avoiding its errors and advancing on its progress, strive to do the truest honour to our work and to our age.

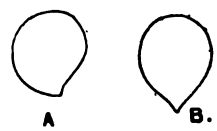
Kingsley Gate School, Wimbledon.

Degenerating Blood-clot.

By A. H. Taylor.

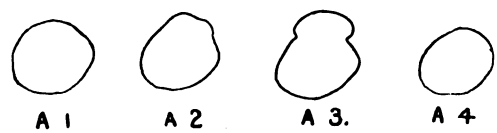
Part III.—Red Corpuscles.

In later experiments the temperature was noted by a thermometer. In one case—bullock's blood on the fourth day—heat up to 90° F. was applied. "A" grew round and drifted off the field. "B" also grew round, and the hot water was shut off; but when the temperature fell to 85° F. "B" melted away. Several other red cells also melted.



In this case the solution used was the same as that mentioned above, except that instead of $Mg_2 (NH_4)_2 P_2 O_8$, $Mg SO_4$ was used, 0·134 per thousand, $Ca H_4 P_2 O_8$ 0·173, and benzoic acid 0·15 per thousand parts of water.

A slide from the same clot on the fifth day showed several long-shaped and peaked corpuscles near the edge of the drop. The temperature was raised from 60° F. to 80° F. for a minute only: all calls became round or rounder; some again grew long-shaped when it slowly fell to 70° F. The temperature was again raised to 90° F., and the stage cooled very slowly; one apparently round cell seemed with a quivering motion to put out a bud ("A 2" and "A 3"), sprang suddenly about four times its length forward, and remained round. This *might* have been a dumb-bell of which one end was uppermost first and



last, but which in the interim gained a horizontal position. The apparently spontaneous movement forward *may* have been caused by a bacterium or bacillus, of which there were several present and moving in the field. Shortly after this movement was noted the corpuscles began to die away markedly.

By the ninth day the degeneration of the clot, originally about half an inch square, had gone on so rapidly, and the death and falling out of the red cells had been so great, that it was reduced to a fragment about one-eighth of an inch long and broad. The first four days after the blood was drawn the temperature of the room was above 70° F., and two thunderstorms occurred during that time. On the third day the clot was seen to be already dark coloured below, where it touched the solution, which was tinged so early slightly red. The upper surface of the clot, exposed to moist air, was red. It was then laid on a wet piece of muslin, the edges of which dipped into the solution, and covered by another wet piece, also dipping in, and placed near an open window. Under this treatment it recovered its colour; a day later the temperature fell to 60° F. The small bit of clot which remained on the ninth day was laid on the cover glass, lower surface downmost; then it was removed, and a drop of the solution added to the resulting mark. No crenated cells were noticed; some were misshapen, some oval, and the round ones seemed mostly thin in the centre. Some red cells were

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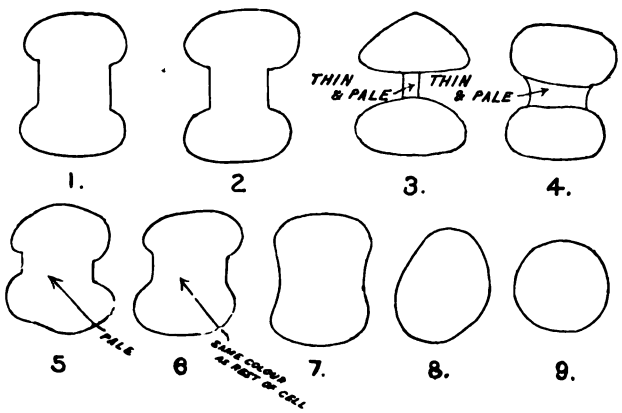
twice the size of others; some, again, were almost a quarter the size of the majority. Several coarsely-granular white were noted. Micrococci were present; few, if any, rods. Many crystals (in shape like those of oxy-hæmoglobin) were present.

Several long-shaped red cells, inclined to dumb-bell form, were noticed. The one watched was nearly double the size of the majority of the round cells. At first thick in the middle, it grew so thin in diameter that it seemed going to divide. At first it was of the same colour all through, but the connecting band grew paler, until, in No. 3, it was of a much lighter colour than the two ends. These, at first round, grew, one oval, the other squarish, then rather triangular, both changing shape with a sort of quivering motion. Their outlines were then very distinct all round, even past the band. Instead of dividing, however,



the cell passed back to its original form, becoming again all one shade of colour, then it became more square—less long-shaped—than at first, then smaller and oval, then round and about the size of most of the other corpuscles, but of a deeper green. After remaining four or five minutes stationary it grew pale and paler, then rather larger and quite transparent, and then only the faintest possible transparent ring was left visible.

The changes from 1 to 3 occupied about three-quarters of an hour, from 3 to 5 about the same time from 5 to 9 about half an hour. In this case no heat at all was applied, the changes were slow and gradual, and no change of position of the long diameter of the cell would account for the changes of form. It is also interesting, because so often the shape of a red corpuscle during the degeneration of the clot suggests division, and also as adding another proof that these changes are apt to occur when the cell is approaching its own death, or when many of the other red cells are dying.

Thus it would seem that, while change of form is a natural function of the white corpuscles, and disappears as they degenerate, on the other hand, perhaps crenation, and probably misshapen forms, are a sign of degeneration and approaching death of the red cell. Bacteria are present in increasing numbers from an early stage, the time at which they appear and their number being dependent, apparently, partly on the temperature of the atmosphere, partly on the solution used, and still more on the number of red cells present in the clot. (The experiments on which the last statement is founded may be given in a later paper.) Is their presence a cause of these changes of form? Or do they appear as a consequence of the degeneration of the red cells—a degeneration evidenced, among other things, by altered shape?

The normal body temperature of bullocks and sheep may differ by some degrees from that of man, yet it seems strange that, raising the temperature to 90° F., a point, at that stage of degeneration, sufficient to bring the corpuscles to the normal round shape, should also cause the death of many, the heat seeming to grow more and more injurious as the degeneration of the clot advances.

The red corpuscles in pernicious anæmia have been noticed of abnormal form, often being oval or tailed, or irregularly shaped. Abnormal forms of the red corpuscles have also been observed after severe burns.

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Oyster Beds and the Ravages of Starfish.

MR. C. F. HODGE, Naturalist on the United States steamer "Fish Hawk," belonging to the U.S. Fish Commission, gives in the *Johns Hopkins University Circular* of September last, with the permission of Professor McDonald, U.S. Commissioner of Fish and Fisheries, a brief outline of work done in the study of the oyster beds of Long Island Sound with reference to the ravages of starfish. He writes as follows:—

"It is well known that the starfish has for a long time been causing many thousand dollars damage annually to the oyster beds of Long Island Sound and neighbouring waters. And since the food of a species is the most important factor in determining its numbers, attempts at increasing the supply of oysters have resulted in an alarming increase of starfish until the oyster industry of the Sound is in imminent peril. Accordingly the direct purpose of the investigation is the discovery of some method by which the starfish may be held in check and the oyster industry relieved of so discouraging a burden.

"Very briefly, the plan, as projected by the Commissioner and Professor Rathbun, aims at the attainment of a thorough knowledge of the natural history of the starfish from the embryo to the adult, as related both to its physical and biological environment.

"One fact, long established, renders it of prime importance to determine the physical limits to the habitat of the starfish. This is the fact that oysters can live in water much less salty than that required by starfish. It is significant in this connection that, so far as known, no member of the group Echinodermata has ever become inured to fresh water. And further, in geological changes, where large marine basins have gradually become fresh, Echinodermata are among the first to die out as brackish and fresh water types make their appearance.

"The salinity of sea water is most conveniently expressed in terms of its specific gravity. Thus average ocean water has a density of 1·027. The oyster thrives best in water of a specific gravity between 1·014 and 1·022, the extreme limits being probably 1·003—1·023. A beginning has been made towards ascertaining these limits for the starfish. The method consists in locating stations at desirable distances apart in the region to be investigated, and over each station a number of observations of temperature and specific gravity are taken on different tides and for the water of top, bottom, and intermediate depth. Dips with trawl or dredge are also taken, and contents noted. Supplemented by diligent enquiry among the fishermen and oyster growers of the vicinity, this method has indicated that the fresh water limit to the starfish is about 1·01875. This, of course, is only provisional, and is based on the supposition that the water during September shows the average condition in the vicinity for the whole year. But this figure, if even approximately correct, supports the often advanced theory that the water of the Chesapeake is too fresh for starfish to thrive in. Professor Ryder gives the density of the Chesapeake at St. Jerome's Creek as varying between 1·007 and 1·010. The Chincoteague at Stockton should also be protected from starfish, if the density of its water is, as given, 1·0175 to 1·02c. It is probable, however, that the limit is fixed not by the average but rather by the minimal density of the water for the year. A case in point occurred in Providence River in February of 1886. At that time a freshet occurred, which killed the starfish in the river three miles below their former limits, and up to last September they had not recovered more than a mile of that distance. It is true this case is complicated, though I think not vitiated, by the efforts of the oyster growers to destroy the starfish as they worked their way up the river.

"This department of the subject needs further investigation, and the results will be of great value to oyster culture in general. But the bulk of the oyster beds of Long Island Sound lie outside the 1·01875 limit in water which reaches a density of 1·022. It is dealing with the starfish here that its complete natural history is needed. They are said to appear suddenly in great numbers. Where do they come from? How do they come? Are their migrations determined in any measure by currents or tides or by the seasons of the year? or are they conditioned solely by food supply? How do they seek their food, or how are they guided to it? What especially are their habits during the breeding season?

"These are a few of the questions on which the Commissioner desires to obtain information, and they reveal the scope and character of the investigation. Space does not permit any discussion of these points at present, and much more work must be done before definite results can be reached. The indications already obtained, however, point to a satisfactory solution of the problem."

This investigation is certainly well worth following up, and we hope it may be further extended, not only on the American coast but on the shores of our own and other countries.

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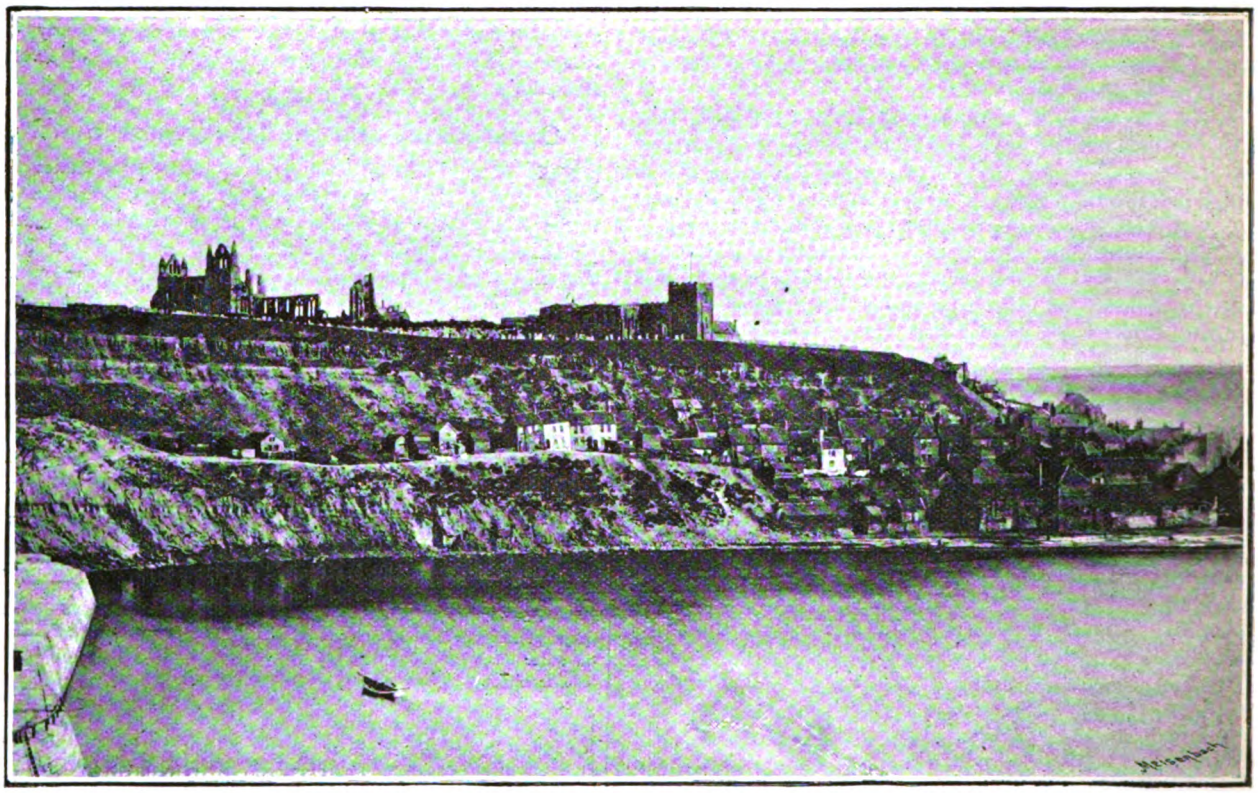


East Cliff and Abbey, Whitby.

(From a Photograph by Valentine & Sons, Dundee).

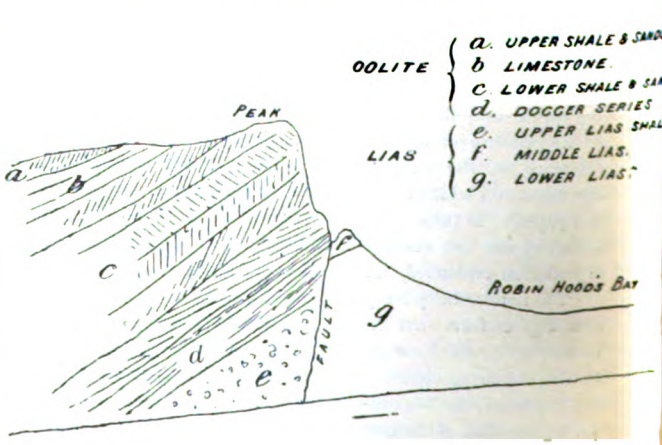
Scientific Aspects of Health Resorts.

VII.—Whitby and District.

THE popularity of Whitby with the artists, the *literati*, and the weary professional men seems to increase, as shown by the lists of names which the good people of this northern watering-place so proudly peruse. And, although so popular with some classes of society, it is not well known to all. Excursions from the large towns, which familiarise our watering-places to all classes, run very seldom indeed, for some occult reason, to Whitby; hence a short visit can only be paid at distant intervals by those whose time is compulsorily limited. Those, however, who have travelled either by land or sea to Whitby will never forget the beauty of the scenery on the way. It is not too much to say that the railway journey from Pickering to Whitby is, for scenery, one of the finest in England. Soon after leaving Pickering the train pursues its slow and devious way up Newtondale, and the geologist must be on the alert to study the fine lessons in physical geology he has on both sides of the rail. Seldom can he have such an opportunity of observing how denudation can produce such striking effects in the configuration of the country. We are travelling at the base of the Oolitic or Tabular Hills, and, after a while, pass into the Vale of Goathland, where the scenery is again picturesque. We cross over the basaltic dyke near Grosmont, and are now upon the Lias, for the study of which we presume we are to visit Whitby. Soon the quaint old town is in sight, with the red-tiled houses, tier above tier, we are so familiar with from countless pictures, and above, on the right, the curious parish church, and still higher, prominent for miles round, the stately ruins of the once beautiful Abbey of St. Hilda. We must ascend the time-worn steps to the latter, if only for the wide and commanding views over land and sea; and on the way some weather-worn Whitby dame at her little stall is sure to ask you to inspect her small stock of fossils, and to expatiate on the beauty and cheapness of her "snake-stones." Thus we can make our stay at Whitby for a few days, and, by diligent study of the magnificent cliff sections in the neighbourhood, become much better acquainted with the Liassic rocks, as our previous visits to Scarborough and Bridlington have instructed us in those of the Oolitic and Cretaceous. Before starting, however, we should visit the Museum, near the Pier, which the veteran curator, Martin Simpson, has had so long under his care, and inspect the fine ammonites, saurian remains, &c., which the surrounding rocks have yielded With this experience, and one of the little handbooks to the

Section at the Peak.

— after Phillips. —



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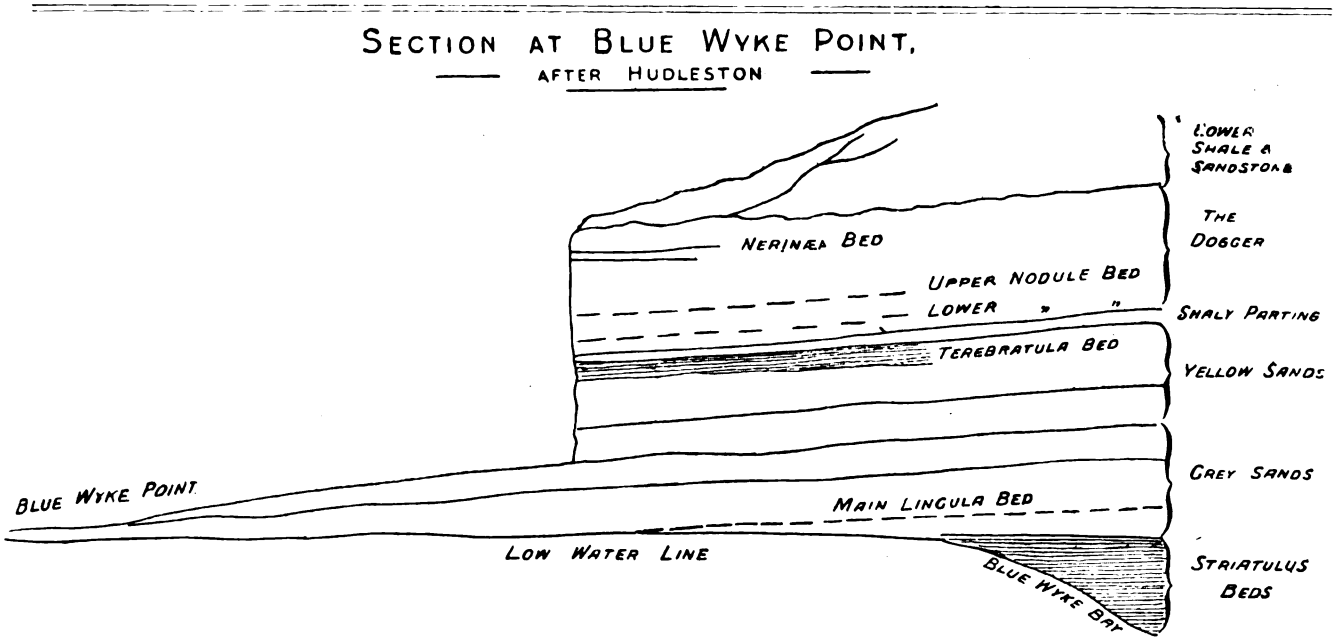
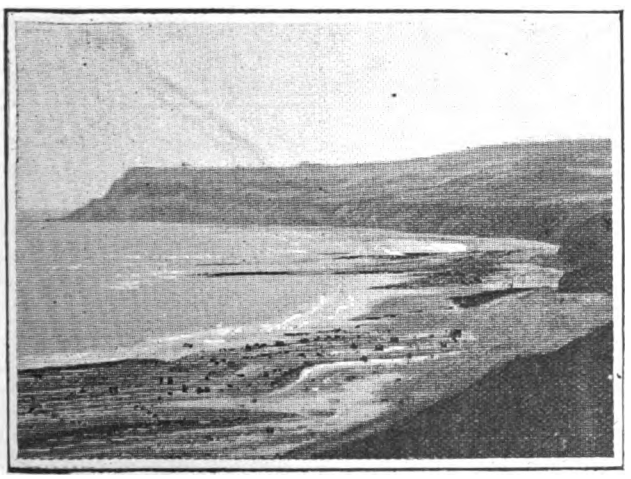


Lias which Mr. Simpson has published, also armed with one of these special hammers with a long, sharp point to dig more easily into the shales, we can set off on our research into the Lias.

Perhaps the best course to take is to go by train from Whitby to the Peak station, there alight, and proceed to visit the Crag Hall Quarry, where there is a most instructive section. This quarry is simply an immense excavation made in former days, when the alum shales, or "communis" beds of the Upper Lias were of great value. Now the residuals from our gas works have supplanted this industry of the Yorkshire coast; these deserted alum works at various points, with the gigantic heaps close by of shale, *debris*, and calcined material, are melancholy monuments of this departed industry, whose disappearance is due to the advance and development of modern chemistry. In the Crag Hall section may be noted the Lower Estuarine shales and sandstones resting upon the Dogger series (base of the Lower Oolite), which rest in turn upon the alum shale alluded to. If favoured with a clear day the view from the top of the Peak Cliff (one of the loftiest in England, being about 600 feet in height) will not easily be forgotten for its wide expanse in all directions. The blue waters of the German Ocean, dotted with white-sailed craft and stately steamers, present a lively scene, whilst the pastures and moorlands of the interior are rich with colour. In the cliff may be seen the effects of that great fault which, from the days of Young and Bird, has been so ably described by successive geologists. The throw of this fault is about 400 feet, and the Middle Lias is brought into contact with the Lower Estuarine beds of the Inferior Oolite. We may descend to the shore and view the section at Blue Wyke Point, which, as Mr. Hudleston observes, "is to a geologist perhaps the most interesting spot on the whole coast of Yorkshire."



ROBIN HOOD'S BAY.
(From a Photograph by Valentine & Sons, Dundee).

That quaint village about three miles away on the shores of the bay, with again a view of red-tiled houses, rising tier above tier, and presenting such a contrast in colour to the surrounding tints of ocean and cliff, is Bay Town, to which, along the pleasant sands, we will wend our way. The cliffs round the middle part of the bay are but low, and are thickly covered with glacial deposits. The Lower Boulder Clay contains many far-travelled rocks, and, as we pass along the beach, we can note several large blocks of Shap Fell granite, washed out of this clay. The little beck which rises on Fylingdale's Moor and runs to the sea has excavated the boulder clay, forming the ravine, upon the steep sides of which the romantic houses of Bay Town are perched. There is ample opportunity for the fossil collector in the Liassic shales, which he can examine at his will if he can spare a few days to make Bay Town his centre.

It is a splendid walk from Robin Hood's Bay to Whitby along the cliff top, and a descent may be made, for instance, at Saltwick, to examine leisurely the sections in the Upper Lias. This is one of the quietest and most pleasant resting-places on the coast, and, as in this sequestered nook the wants of the inner man can be attended to in the homely but comfortable refreshment room close to the shore, a longer stay can be devoted to the sections alluded to.

We have had the Upper Lias with us for some time, but at Whitby we have a change, owing to a fault. As the Government geologists point out, Whitby East Pier is built on alum shale, but the West Pier is on Oolitic sandstone. "Standing on the pier-head at low water a line of breakers may be seen, commencing at Saltwick Nab and ending some distance out to sea, due north of the harbour. This marks the outcrop of the Jet Rock, which is abruptly terminated by the fault. The sandstones and shales in the low cliff under the Royal Hotel are not far below the Grey Limestone, while the Dogger is at the base of the East Cliff. The break here must, consequently, be some 200 feet."

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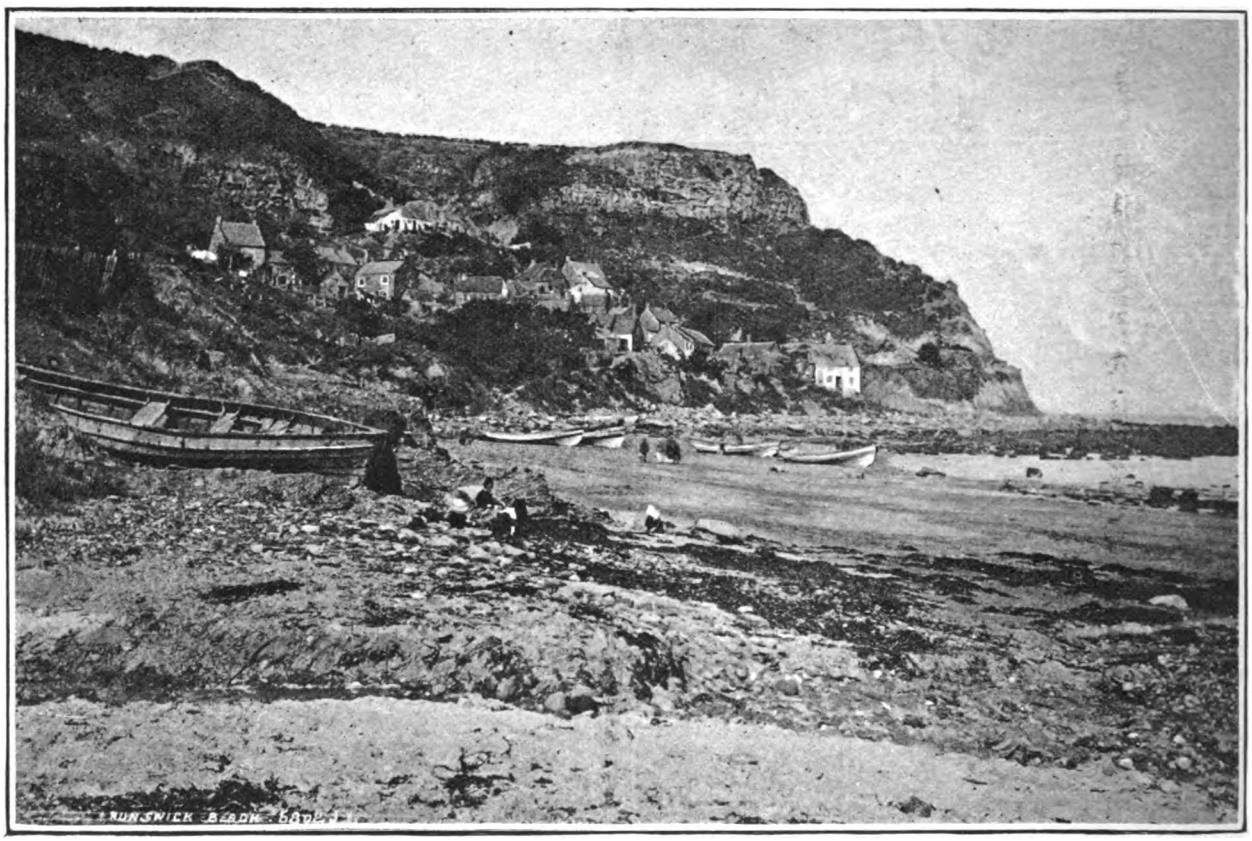
We now have glacial deposits again until we reach Sandsend, not coming upon the alum shales before we get past the railway station at the latter place. In the boulder clay great landslips at times take place; at Upgang, a few years ago, there was a very extensive one, which destroyed the roadside hostelry. If we make a *detour* just before reaching Sandsend to the high road, we may examine an outcrop of impure silicious ironstone, which belongs to the Dogger series.

We can now take the way leisurely along the base of the cliffs, although, as the writer experienced, the walk is somewhat arduous in some places. The vivid colouring the cliffs present will be sure to excite our admiration. It would require the genius of a great painter to adequately pourtray them, and even then, if faithfully reproduced, the magnificent tints would excite incredulity in those who had not seen the originals in Nature. As the Rev. Maule Cole eloquently says, "The cliffs on the coast, from Sandsend to Kettleness, present a colouring which is rarely to be met with. Huge, massive yellow sandstones form the top of the cliffs; below are green-coated slopes of variegated shales, and at the base dark blue and black walls of rock, resting on a level, pearly-grey pavement, covered with tangled sea-weed." We proceed along upon the beds of hard blue shale of the zone of *Ammonites communis*, which, when weathered, break up into very small fragments, and make the footing rather insecure. In the upper part of this zone are lines of nodules (we may have seen some heaps of them on the roadside at Sandsend), which are used for the manufacture of hydraulic cement, that known as the "Mulgrave" cement.

We next come upon the shales of the zone of *A. serpentinus*, in which occurs that bituminous rock containing the well-known substance we are so familiar with as jet. And we may see, too, the solitary jet worker hewing into the cliff in the pursuit of his precarious and dangerous livelihood. The micaceous sandy shales of *A. annulatus* come next, but when the writer took this expedition they were much obscured by falls of sandstone. These shales contain rows of clayey ferruginous limestone balls in places, which, when broken, may be found to contain sometimes specimens of a portion of an ammonite, or the alveolus of a belemnite. We shall have noticed also on the shales large cheese-shaped doggers, around which the shale has been washed away, leaving them like small tables. And in these shales the special hammer may be used to good purpose and some beautiful fossils obtained.

Another arduous effort will bring us round Kettleness, and we are in Runswick Bay, which is one of the most picturesque bits of scenery on the coast. At the west end of the bay is the little village, the houses of which, as White truly remarks, "hang on the abrupt hillside as martens' nests on a wall." The shores of the bay are guarded by low cliffs of boulder clay, the latter filling up an ancient valley of pre glacial times. Travelled blocks, including some of Shap Fell granite, may be seen. Runswick, like Bay Town, is an admirable place for complete rest and thorough enjoyment of the beautiful scenery around. Here the geologist, in the quietude of this charming resort, may review his notes and study his observations, at the same time invigorating his health and renewing his strength.



RUNSWICK BAY. *(From a Photograph by Valentine & Sons, Dundee).*

For further details the reader may consult the Memoirs of the Geological Survey:—*Geology of the Country between Whitby and Scarborough* (1/6), by C. Fox Strangways, F.G.S, and G. Barrow, F.G.S., and the *Geology of North Cleveland* (1/6), by G. Barrow, F.G.S. Tate and Blake's *Yorkshire Lias* is indispensable, and Maule Cole's *Popular Handbook* will also be useful. The Geological Survey maps are quarter sheets 95 N.W., 104 S.W., and 104 S.E. S. A. A.

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Notes in Brief.

It is announced that the next meeting of the Photographic Convention of the United Kingdom will be held in 1890, at Chester, under the presidency of Mr. Bothamley, assistant lecturer and demonstrator in the chemical department of Yorkshire College.

An American discovery is the subject of another sensational announcement to the photographic world. This is no more or less than a compound which allows the development of sensitive photographic plates in daylight, without the necessity of the "dark-room." Such wonderful qualities seem too good to be true, and some confirmation of the reputed "discovery" is anxiously awaited by the brethren of the camera.

Not content with his recently-gained laurels for his journey across Greenland, Dr. Nansen is said to be desirous of undertaking a new North Polar Expedition. He purposes to use a small vessel to take his party as far north as they can get, and then to depend upon small boats and sledges. A large sum of money has, it is said, already been raised for the furtherance of this scheme, and, as an incentive to subscribers, the young and intrepid explorer announces his firm resolve not to turn back until he reaches the Pole.

A Technological Class for Shoemakers has been projected by the Leeds Boot and Shoe Manufacturers' Association, under the auspices of the City and Guilds of London Institute, and a competent lecturer has been provided in the person of Mr. George Wyld. At the conclusion of the introductory lecture 22 students joined the class, which will be instructed in every branch of the trade.

Mr. William Wilson, Junr., of Hillock, Terpersie, Alford, Aberdeenshire, has in the press for immediate publication, at a low price, a useful work entitled *Practical Observations on Agricultural Grasses*. The work, which is to be illustrated with woodcuts of the leading grasses and clovers, also some plants of pastoral value, is written by an author of great experience as a practical and scientific farmer, who is also no mean botanist. It will doubtless find a ready sale.

Eight new fountains of petroleum have been discovered in the naphtha-producing territory of the district of Baku, and the Vice-Consul at Batoum has sent home information that the combined output of the district at present rates of supply was approximately estimated at 16,000 tons per day.

If the depredations, described by the honorary curator of the Wiltshire Museum as constantly occurring at Stonehenge, be allowed to continue, the most marvellously preserved megalithic monument in Europe will soon be a thing of the past. He writes as follows:—

"I do not want to see the excursionist kept out altogether, but I want a certain protection put over Stonehenge, that such acts as sliding down the face of one of the fallen stones, cutting initials in the turf inside the circle, scratching and chalking initials on the stones, picnicing inside the circle, throwing broken (or otherwise) bottles about, with pieces of cucumber rind now and then, and any other kind of litter will be prevented. All of the above acts of desecration I witnessed one day last week. It is idle to say that there is no appreciable difference in the condition of Stonehenge to what it was fifty years ago. It is in a far worse state than it was fifteen years ago, when I first went there; and the old man who used to look after it is dead. Now is the time for all archæological and antiquarian societies to come forward together and do their utmost to get this, the grandest of our ancient monuments, placed under Government protection."

An Educational Congress has just concluded its sittings in Paris. The delegates came from several countries of Europe. A resolution was passed that public education should have a scientific character, and should employ the experimental and deductive methods of observation.

The report of the third year's work of the Yorkshire Boulder Committee, drawn up by its active and energetic honorary secretary, Mr. S. A. Adamson, F.G.S. (52, Wellclose Terrace, Leeds), is now before us, from which it is evident that a very profitable year's work has rewarded the exertions of the committee. Nearly the whole of the observations reported are the result of personal visits by members of the committee, who have not only added very materially to the records of Yorkshire erratics, but have also succeeded in throwing light on some obscure points in the glacial geology of that county. A boulder map has been prepared—a valuable adjunct to the committee's work—upon which are denoted the position and classification of the various erratics reported. The committee, in thanking their contributors, trust that the valuable work accomplished and the recognition it has obtained will prove an incentive to further efforts. The following observers contribute reports:—S. Chadwick, F.G.S.; Rev. R. A. Summerfield, B.A.; W. F. K. Stock, F.I.C.; Rev. E. Maule Cole, F.G.S.; Wm. Watts, F.G.S; C. Brownridge, F.G.S.; Rev. E. P. Knubley, M.A.; Wm. Gregson; R. Mortimer; and Rev. Arthur Watts, F.G.S.; and their observations have been assisted by a large number of willing helpers in all parts of the county. The complete report will be found in the October number of the *Naturalist*.

At the recent distribution of Queen's prizes to the students under the Manchester School Board, several speakers addressed the meeting on the subject of technical education. Mr. Herbert Birley, who occupied the chair, stated that provision had been made for an increased number of students, and that already they had nearly 5,000 pupils on the rolls of the elementary evening classes. The Corporation of Manchester were doing much to aid the cause of technical education, and so "keep British trade at home."

Mr. W. Harcourt Bath, of the *Naturalists' Gazette*, has sent us a specimen of one of his "label" lists of British birds' eggs. The list gives the names of the principal British birds printed in letters of suitable sizes on gummed paper, and, being neatly executed and very inexpensive, it will doubtless be of great use to those collectors who wish to label their specimens.

The report of the Manchester Technical School and Mechanics' Institute shows a steady progress in all the chief departments of the school. The present building has become quite inadequate, both in point of extent and equipment, for the increased number of pupils. If incorporated within the scheme of the Manchester Whitworth Institute it could not fail to take highest rank amongst English technical schools.

It is proposed to form a Physical Society in Liverpool, and to hold the meetings at University College. A circular has been issued inviting all classes of students and all interested in physical subjects to attend the preliminary meeting of this new society, which will be held in the physics theatre of University College, at 8 p.m., on Wednesday, November 6th, when Professor Oliver Lodge, who has consented to be nominated as first president, will take the chair. The secretary (*pro tem.*) is Mr. Thomas Tarleton, 1, Hyde Road, Waterloo, Liverpool.

The Dinsmore process of gas manufacture appears to be giving very excellent results, and both plant and working operations have lately been much simplified by the alteration of taking the tar into the "duct" in a gaseous instead of in a liquid form. Mr. Carr, engineer to the Widnes Local Board, reported to his committee, on September 30, that two weeks' working of the process with Abram Arley slack, which costs only 6s. per ton at the works, gave the following results:—Gas, per ton of slack, 11,300 cubic feet; illuminating power (average), 20·74 candles; tar used per ton of coal carbonised, 4½ gallons.

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A VERY satisfactory report has also been issued by the Yorkshire College, who have to record an advance in the attendance of students at the classes. The council have determined to erect a building to be devoted to the medical department of the college, and a College Hall and Library for meetings and examinations. After the annual distribution of prizes, addresses were delivered by the Marquis of Ripon and Lord Houghton.

AT the opening of the session of the Owens College, Manchester, on 1st October, Professor Arthur Schuster gave an address on "University Teaching in its Relation to the Industrial Applications of Science." On the same evening a *conversazione* was held to celebrate the opening of the college department of medicine.

THE syllabus of the Chester School of Science and Art for the session 1889-90, shows that in that ancient city excellent provision is made for instruction both in art and science subjects. The instruction afforded in the art division includes geometrical, perspective, freehand and model drawing; architectural and mechanical drawing and colouring; drawing and shading in chalk and tint; painting in oil, water-colour, tempera, &c., from copies, casts, flowers, fruit, still-life, drapery, landscape, animals and the living model; anatomy; modelling in clay and wax; study of plant and ornamental forms for decorative purposes; designing for art manufactures and decoration; wood carving; etching on copper. The subjects taught in the science division being machine construction and drawing, mathematics, applied mechanics, inorganic chemistry (theoretical and practical), geology, mineralogy, animal physiology, botany, steam and the steam engine, physiography, principles of agriculture. There is also an excellent engineering course, and also extra classes in the following useful subjects, viz.:—Theory of music; elements of music, sight reading and voice production; French, German, Italian, Pitman's phonetic shorthand; and a class in connection with St. John's Ambulance Association.

TWO REMARKABLE PEBBLES.—At the last meeting of the Leeds Geological Association, two most remarkable pebbles were exhibited by Mr. William Cheetham, of Horsforth. They are of hard compact sandstone, and were obtained by that gentleman from boulder clay, at an elevation of about 400 feet, at Laister Dyke. When broken, they disclosed a striking history—one being found to contain a fine example of a portion of a calamite, the other having a splendid impress of one of those beautiful ferns of the Coal Period, known as *Neuropteris*. One pebble is flat, and half of an ellipse in form, the other is also flat and roughly square; both are highly smoothed, and also striated, the striæ being in different directions. Thus these pebbles have distinctly inscribed upon them by Nature's graphic hand two epochs, separated from each other by an immense period of time, and exactly opposite to each other in character. The fossils being of the Carboniferous Period, the smoothing and striæ of the Glacial; one tropical, the other boreal—the one enabling us to picture Yorkshire clothed with luxuriant vegetation, the other with the icy stillness of Greenland.

Foreign Jottings.

DR. KUHNEMAU, assistant in Dr. Schweniger's celebrated laboratory in Berlin, has discovered a bacillus in human warts. This bacillus is often the cause of skin diseases, and causes contagion of warts.

PROFESSOR P. G. ROSÉN, of Stockholm, is engaged in effecting astronomical and pendulum observations in Swedish Lapland, in connection with the series of international terrestrial measurements now being made. His instruments are connected with similar ones stationed at Hernosand, on the Baltic, where observations are also effected.

THE temperature in Russia this summer has been very abnormal, having been some 20° C. above the average, whilst very little rain has fallen.

THE Russian expedition to Thibet, which, upon the death of the celebrated General Prjevalski was entrusted to Colonel Pevtzov, has penetrated into Kaschgaria. The health is good, and the expedition is now hastening towards the oasis Niam, at the foot of the Thibetan mountains, which it will make its headquarters.

FROM Kaschgar comes advice that a memorial has been raised there in honour of the famous German traveller and climber of the Himalayas, Adolf Schlagintweit. It consists of a pyramid and an iron cross, and stands on the spot where the explorer was murdered by order of the then ruler of Kaschgar, August 26, 1857.

A BILL has been introduced into the Norwegian Storthing for restricting the shooting of reindeer to one month (August 15—September 15). In consequence of preservation reindeer and elk have augmented greatly in Norway during late years.

ON the Norwegian ship "Merkur" returning from the South Seas the other day and was docked, two swords of the sword-fish were found in her bottom near each other. They had been rammed in with such force that not a drop of water had leaked in, and it was impossible to extricate them.

DURING the summer the Danish war ship "Tylla" has been engaged in sounding and charting the seas around Iceland, and a new dangerous reef, where there is only seven feet of water, has been discovered. It is believed to be due to recent volcanic upheaval.

A NATURAL HISTORY MUSEUM is being formed at Reikjavik, in Iceland.

AN interesting work has just appeared at Copenhagen upon the parasitical fungi of the Danish forests, with numerous illustrations, by the well-known botanist, Dr. Rostrup.

A SINKING of the northern coast of France has recently been proved by measurements. Since 1884 the "genie" corps of engineers have been engaged in effecting level measurements over the whole country, and it has been shown that the country sinks from the south towards the north. Thus, between Marseilles and Lille—a distance of 820 kilometres—the sinking amounts to 23 centimetres annually. If this movement continues the northern part of France may in a few centuries become submerged. It may here be mentioned that off the coast of St. Malo in fine weather fossilised trunks of trees may be seen at the bottom of the sea, indicating that these parts were once above water.

AT the recent anthropological congress in Vienna Professor Virchow read an exceedingly interesting and valuable paper on the progress made by anthropological science during the last 20 years. He dwelt particularly upon the views which had been changed in that period, and the positive advance that could be boasted of. Many prejudices have been overcome, and the problems to be solved were in consequence more defined. One of the principal objects of the congress was to establish and develop a uniform mode of research. The researches which particularly were to be furthered concerned the question of *how individual races became blended*; whether changes of climate, mode of living, or other circumstances could *produce a new race*. If this was shown to be the case it might be concluded that the existing races had emerged from more simple and primitive ones.

THE earthquake theory of Dr. Rudolf Falb, to which we referred in our last issue, is the object of severe criticism by Dr. E. Kassner in a German journal. The author maintains that the theory respecting "critical" days rests upon a false basis. Severe scientific investigation has certainly disclosed the fact that the sun and the moon have some influence upon terrestrial phenomena, but they do not, as maintained by Dr. Falb, *cause* them. When authorities continually oppose Falb's theory it is done in the interests of science. He has been given a latitude which would never be shown towards a meteorological institute, which would be severely blamed

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if its forecasts were not right, whilst Falb's phenomena may occur days before or after the "critical" day, and may consist of earthquake, storm, thunder, floods, or waterspouts, and still the "theory" has proved to be correct. *Apropos* of Dr. Falb's lastly-predicted critical date, July 28, it may be mentioned that on that day a terrible earthquake occurred at Kumamota, in the island of Kiensin, near Nangasaki, doing immense damage.

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THE "weather" plant continues to attract much interest in Vienna, and *savants* who at first were sceptically disposed towards it now admit its prophetic powers. 32,000 experiments with the plant have now been carried out, and have, it is said, shown its infallibility. The common name of the plant is "Paternoster Cheese," and its Latin one *Abrus peregrinus*. Its home is Corsica and Tunis. The stem and leaves are similar to those of the Cactus. The tenderest leaves on the topmost shoots are said to forecast the weather 48 hours, and the lower stronger ones three days. The change of weather is indicated by the rising and falling of leaves and shoots.

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FORMERLY there were no sharks in the Mediterranean, although now and then a stray one might have followed some ship from South Africa through the Straits of Gibraltar, but since the opening of the Suez Canal a change has taken place. Large numbers of them now pass through it, particularly going to the Adriatic Sea, whither many ships are bound. Thus, a large female shark has just been caught in the Bay of Fiume, having got entangled in some mackerel nets, whilst another has been harpooned at Pola, close to the public baths, and a third one also near that port, 2·15 metres long, having teeth from 2 to 6 centimetres in length. It is, therefore, feared that the immigration of sharks will greatly affect the Mediterranean ports as bathing resorts.

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THE observatory at Pekin is the oldest in the world, having been founded in 1279 by Kublai Khan, the first emperor of the Mogul dynasty. There are still in it three of the first instruments of observation. These were used for the observation of Halley's comet in 1738, and may also be used when 22 years hence this comet again appears. The oldest observatory in Europe is that founded by King Frederick III. of Denmark on the island of Hveen, in the Sound, and where the famous Danish astronomer, Tycho Brahe, carried out his celebrated observations, among others, that of the "bright" star in Cassiopeia. The Paris observatory was established in 1671, and that of Greenwich three years later.

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Writing in a South American journal a Spanish traveller states that the largest waterfall on that continent is that of Sete Quedas, or "Seven Waterfalls," formed by the river Paraña. It is as majestic as that of Niagara. The fall is 80 feet, and the quantity of water precipitated estimated at 20,000 cubic metres per second. The vapours from the fall may be seen for miles, and the roar heard for 20 miles.

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British Association, 1889.

Gleanings from the Sections.

THE ERECTNESS OF MAN AS COMPARED WITH APES.

PROFESSOR CUNNINGHAM, in speaking of "The Proportion of Bone to Cartilage in the Lumbar Section of the Vertebral Column in the Apes and in Different Races of Men," said he desired to show some modifications which showed the result of the erect posture of man, and in looking at the vertical column, because it was in it that he especially looked for these modifications, there was no part in which they would expect to find such modifications more marked than in the lumbar region—the region of the loins, because it was upon this a great part of the weight of the limbs and trunk fell. If they examined the bodies of the lumbar vertebræ (which supported the weight of the trunk in man) in a number of animals, they found that in quadrupeds these bodies were long, narrow, and rod-like, placed one in front of the other, whereas in man they found that the bodies were short, broad, and disc-like, so as to widen the pillar of support. But the point of interest in this was that the gradations between these rod-like vertebræ and the disc-like body of vertebræ could be traced step by step as they passed up through the apes. After considering these facts, he began to think it possible that similar distinctions might be denoted in some of the lower races.

THE OCCASIONAL EIGHTH TRUE RIB.

Professor J. D. Cunningham, in speaking on this subject in its relation to "right-handedness," said that as a rule there were seven ribs on each side attached to the sternum, but occasionally an eighth rib was so attached. In 63 subjects examined—42 females and 21 males—an eighth rib was found in 20 per cent. In five this eighth true rib was present on both sides and in nine on one side only, and that the right side, and only in one on the left. He believed the marked preference it had for the right side was due to right-handedness,

LEFT-LEGGEDNESS.

Dr. W. K. Sibley said that Professor Ball, in *Le Dualisme Cérébral*, speaks of man as a right-handed animal. Being right-handed, it is popularly assumed that he is also right-legged; but this does not appear to be the case. Standing working with the right hand there is a tendency to use the left leg for balance. Many people find less exertion in going round circles to the right than to the left; race-paths are nearly always made for running in circles to the right. So the majority of movements are more readily performed to the right, as dancing, running, &c. The rule in walking is to keep to the right, and this appears to be almost universal. It is more natural to bear to the right. Of a large number of people from the better-educated classes asked about the existence of the rule, only 67 per cent. males and 53 per cent. females were aware of the rule; the large body obey it unconsciously in walking. Crowds tend to bear to the right. The left leg being the stronger, it is more readily brought into action; hence troops start off with the left foot. It is the foot which is placed into the stirrup of the saddle or step of bicycle in mounting, so that the left is the foot which a man takes off from in jumping. In the experiments of Mr. G. H. Darwin, blindfolding boys and telling them to walk straight, the right-handed ones diverged to the right, and *vice versa*. From measurements of Dr. Garson of the skeletons of the two legs, in 54·3 per cent. the left was the longer and 35·8 the right. For measurements of the feet the author collected the drawings and measurements of 200 pairs, for which he is indebted to the courtesy of Mr. Parker, of Oxford-street, with the result that in 44 per cent. the left was longer, in 21·5 per cent. the right, and in 34·5 per cent. they were the same size. Measurement at the first joint gave 56 per cent. left larger, and at the instep 42·5 per cent. From the table of the figures it is observed that the left foot is more frequently the larger in the male than female sex, and the percentage of feet of the same size is greater in the female. The percentage of the right larger than the left is very constant, whereas the numbers of the left larger and those in which both feet were the same size are much more variable. Man, being naturally or artificially right-handed and left-legged, tends unconsciously to bear to the right; lower animals, on the other hand, appear nearly always to circle to the left.

THE VIKINGS THE DIRECT ANCESTORS OF THE ENGLISH-SPEAKING NATIONS.

In a paper on this subject, Mons. Paul B. du Chaillu described the early civilisation and antiquities of the North-men, and dwelt upon the beauty of their ornaments and weapons, and also upon the similarity of Scandinavian and English ornaments belonging to the Early Iron Age, and the love of the Northern people for the sea. He spoke of the three maritime tribes of the north, according to the Romans, and of the fleets of the Sueones in the time of Tacitus; of the expeditions of the so-called Saxons and Franks, and of the homes of these tribes; of the proofs from antiquities found in the North; of the commerce of the North-men with the Roman Empire and with Greece, and also pointed out that the tribes of Germania were not a seafaring people and were uncivilised, according to Roman writers. He gave an account of the probable origin of the names "Saxon" and "Frank," and spoke of the early settlements in Britain by the North-men during the Roman occupation, and of how the name of England might have been given to part of Britain. He alluded to the different countries of the Jutes, and to the fact that England was always called by the North-men one of the Northern lands, and the early Northern kings claimed to own part of England. He mentioned the English and Frankish chronicles, in which Sueones, Danes, and North-men are described, and said that neither Saxons or Franks were a seafaring people either at the time of Charlemagne or at any earlier period. He further dwelt on the mythical settlement of Britain by Hengist and Horsa, given by the English chronicles, which is quite contrary to the Roman records, Sagas, and archæology, and urged that the North-men, or Vikings, were the direct ancestors of the English people.

ANTHROPOMETRIC LABORATORY.

Dr. J. G. Garson submitted reports of the Anthropometric Laboratory Committee, which stated that during the Bath meeting of the British Association the committee made a number of observations. Experience showed that it was desirable to make slight alterations in the card of observations of the previous year on account of some of the observations requiring more time than it was possible to give them, and a much larger staff of assistants than could be obtained. Mr. Francis Galton very kindly placed at the disposal of the committee most of the instruments required. The characters examined were as follows:—The sitting heights, standing height, span of arm, length of the fore-arms from the elbow to tip of middle finger, the length and breadth of the head, of the face and nose, the breathing capacity, the strength of squeeze, weight, the colour sense, the judgment

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of the eye; note was also made of the colour of the hair, of eyes, sex, age, birth, place, and occupation of each individual examined. In all the experiments made, Dr. Garson said, the system of percentiles which Mr. Gordon used in the South Kensington Museum was employed. The system was an extremely useful one, and extremely useful for calculating large numbers of figures. In fact, it saved a great deal of trouble, and it was a wonder to him that it had not been more adopted. He ventured to think that the cause of this had been because in most of Mr. Gordon's publications he had not given diagrams showing the actual method by which these percentiles had been obtained. The places the association visited materially affected the class of persons who were examined—that was to say that in Somerset they met Somersetshire people, and in Lancashire, Lancashire people. The previous researches of committees of the association had shown that in Somersetshire the stature of the people was much less than in Lancashire. That was borne out by the results which they had got in the laboratory. Of course there was a great mixture of people from all provinces, but the fact of the majority being Somersetshire people had undoubtedly had an influence. It would be extremely interesting to find what the result of the present year's laboratory was. If the researches of the previous committees were confirmed, in the north, they should expect that the stature would be somewhat higher. Professor Garson then quoted a number of statistics obtained in the laboratory at Bath. It was rather curious, he said, that they never came across a person pulling with the same strength in both arms. Sometimes they found the left arm stronger, but in the majority of cases the right arm was the stronger of the two.

The Vitality of Pasture Plants.

Professor W. Frean, in a paper on "The Effects of Root-Section on the Vitality of Pasture Plants," described some investigations with the herbage of old grass lands which the author carried out last year, in which turfs nine inches in depth were dug from a number of old pastures in England and Ireland, and transferred to one and the same place, where they were planted to permit of growth and observation. In the discussion that followed the publication of the results, it was argued that certain grasses, conspicuous by their infrequent appearance and small percentages on these turfs, had been killed by cutting at so "shallow" a depth as nine inches. Whilst admitting the established fact that certain plants send their roots to a considerable depth, it appeared to the author that some confusion had been made between root-range, on the one hand, and the effects of root-section, on the other. Certain plants were dug up in early spring, their roots were well washed, and then the roots and root-fibres were cut through with scissors at various depths below the surface, and were afterwards planted out in poor soil and came into bloom. The experiment showed that root-section, even of very deep-rooted plants, may be performed, without fatal results, at exceedingly moderate depths.

The Water in Living Protoplasm.

Professor Marcus Hartog, in speaking on "The State of the Water in Living Protoplasm," said living organisms were transparent; dead ones were opaque, and only returned to transparency when the water they contained was replaced by a medium of much greater refractivity than water. This showed that the water of the living protoplasm must exist in some form of physical combination like water of solution or water of gelification, giving optical homogeneity.

Epinasty and Hyponasty.

Professor Vines read a paper on this subject, in which he explained that the terms referred to the structure of certain parts of the plant body. They presented two flat surfaces of different kinds. They did not grow equally in the period of growth, one sometimes growing at a faster rate than the other, causing the leaf to curl. Hyponasty represented the growth of the lower, and epinasty of the upper surface. The object of the observations described in the paper were twofold: first, to ascertain whether the epinasty and hyponasty exhibited by dorsiventral members were spontaneous or induced, with special reference to Detmer's conclusion that epinasty is induced by light; and, secondly, to ascertain whether the change from the horizontal to the erect position, which is exhibited by many dorsiventral members on being kept for some time in darkness, was due to inherent causes, or to the action of gravity inducing negatively geoptric curvature, as urged by Frank and others.

Erratic Blocks.

Dr. H. W. Crosskey presented a report on "Erratic Blocks." In some cases these blocks were isolated on the ground, while in other cases they were embedded. The thing to which the committee drew attention was the different levels at which those blocks were found. One of the most notable was at Franklin, near Birmingham, at 900 feet above the level of the sea. The object of the committee was to ascertain the exact position of these blocks, their distribution, their relative numbers, and the position in which they were found. He thought the committee had evidence already of the subsidence of the land at least 1,000 feet to account for the presence of those erratics. He thought if they were to trace out what happened while the land was going down—when the ice-covered land was brought into contact with the water and plunged beneath it, and then what happened on the return of ice while the land was rising, and when they had, therefore, the exposure of land freshly covered with ice and the coming down of some local glaciers—if they put these things together, he thought they might ultimately be able, by observations in the Midlands, to mark out deposits and show what happened at each of these periods.

Alloys of Aluminium.

A paper on "The Manufacture of the Alloys of Aluminium in the Electric Furnace" was read by Mr. J. H. J. Dagger, who described the method of production at some of the works in the United States and in Staffordshire. Deville's method, modified in detail, is still the chief of the chemical processes for the production of aluminium, and is dependent upon the cost of metallic sodium. The greatest value of aluminium is, however, in its alloys, and the successful application of the intense heat of the electric arc to their production on a commercial scale marks a departure in electro-metallurgy of which we cannot over-estimate the importance, rendering it possible to produce rich alloys of this metal at half the cost of any other method, and so widening the field of their application to an extent hitherto unknown. At the works of the Cowles Co., Lockport, N.Y., U.S.A., there are in operation 14 furnaces, the electricity for which is generated by three dynamos, capable of supplying a current of 3,000 to 3,200 ampères, and E.M.F. of 55 to 60 volts. These furnaces can produce 2,500 lbs. of aluminium bronze (10 per cent.), and 1,800 lbs. of ferro-aluminium (10 per cent.), or a total yield of 430 lbs. of contained aluminium per 24 hours. The English works of the company at Milton, Staffordshire, contain twelve furnaces, with a 500 horse-power dynamo, built by Messrs. Crompton, and said to be the largest machine in England, and probably in the world; it furnishes a current of 5,000 to 6,000 ampères, with an E.M.F. of 50 to 60 volts. The production of these works is 2,300 lbs. aluminium bronze (10 per cent.), and 1,800 lbs. ferro-aluminium (10 per cent.), per 24 hours, or 410 lbs. of contained aluminium. The most valuable of the alloys of aluminium are those with copper. Aluminium bronze has great tensile strength. A bar containing 11·0 per cent. aluminium made by the electric furnace, and tested by the Leeds Forge Co., Limited, gave a tensile strain of 57·27 tons, or 128,400 lbs. to the square inch. One, containing 7·5 per cent. aluminium, tested by Professor Unwin, broke under 36·78 tons = 89,745 lbs. to the square inch. In resistance to compression this alloy equals the best steel; its transverse strength, or rigidity, is forty times greater than ordinary brass. Its elastic limit is higher than that of mild steel, and it can be worked at a bright red heat as easily as wrought iron. Its mechanical and physical properties render it useful for every variety of metal work, its high price only having hitherto restricted its use. Its enormous strength and anti-corrodible qualities recommend it as valuable above any other alloy for propeller blades, stern and rudder frames, and for hydraulic and engineering work generally. Above 11 per cent. the alloy becomes brittle, and at 20 per cent. can be powdered readily in a mortar. The addition of small quantities of aluminium lowers the fusing point of iron, and this is utilised in the "Mitis" castings. It ensures freedom from holes, increased tensile strength, and high elastic limit. Mr. Keep found that 0·1 per cent. aluminium raised the transverse breaking strength of ½-inch bar, 12 inches long, from 379 lbs. to 545 lbs., or 44 per cent., and the resistance to impact from 239 lbs. to 254 lbs., or 6 per cent. The tensile strength of mitis castings may be as high as 27 tons per square inch, with an elongation of 20 per cent. Another alloy made in the electric furnace is silicon bronze, which, owing to its great strength and tenacity, its resistance to corrosion, combined with high electrical conductivity, is, perhaps, the best metal extant for electric light, telephone, and telegraph wires.

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Museum Holes.

In his recent presidential address to the British Association, Professor Flower emphasised the use of labels, large and small, in the cases of a museum, the value of which, he said, can never be superseded by guide books and catalogues. There can be no doubt that in many of our museums explanatory labels are not utilised to a sufficient extent. They need not necessarily be confined to a narrow strip of cardboard, bearing the name of the specimen and its locality. Large cards should be inserted giving an abstract of the life history of the specimen or groups, and others, again, should be prepared for the purpose of indicating the exact place amongst the natural orders occupied by each object. So called "explanatory" labels and cards only too often are mere strings of technical terms, and to the mind of the average visitor do not "explain" anything.

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One great desideratum in museums is the providing of a competent person who should undertake to be in attendance at certain specified hours, and give genial and simple *vivâ voce* explanations of the objects to inquiring visitors. This duty could well be undertaken by one of the curator's assistants, or someone should be engaged for the purpose. Such a system would do more to popularise museums, and make them of real educational value to the public, than anything else that could be done. It is sad to watch the numbers of persons whose interest only requires to be aroused by some

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friendly mentor, but who, in the absence of any such aid, wander aimlessly through the various rooms as if looking over a storehouse or bazaar.

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At a recent meeting of the Manx Natural History and Antiquarian Society a visit was paid to a small museum of recent origin near Tholt-y-Will. The collections appeared to be of the usual miscellaneous order, ranging from local birds and sea-urchins to trophies from Sebastopol and other famous battle-fields, and embracing Thurot's sword and dagger, Chinese umbrellas, Fiji weapons, Manx coins and manuscript, and the "shoe and cast of the hand of Caley, the Manx giant." An attempt seems to have been made to provide a special collection of local specimens—a praiseworthy idea if carried out. The cases of local birds contained some excellently-mounted specimens of water ouzel, ring ouzel, snow bunting, curlew sandpiper, spotted crake, coot, red-throated diver, puffin, and Arctic tern. Such museums should be exclusively devoted to the display of objects of the locality, and the collections would not lose in value by the elimination of the miscellaneous foreign objects and the Chinese umbrellas.

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The usual course of demonstration lectures at the Manchester Museum, Owens College, commenced on October 17th, when Mr. W. E. Hoyle, M.A., the curator, gave an address on "Crabs, Lobsters, and Barnacles," illustrated by the lime-light. A course of museum lectures is also being given by Professor Williamson, F.R.S. Such lectures as these are eminently useful. A charge of sixpence is made to the public for admission to each lecture or demonstration.

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At the Liverpool Free Public Museum the experimental evening opening which was tried last winter has proved sufficiently successful to encourage renewed effort. During the present winter the museum will be open on Monday evenings, and it has been again arranged to give short half-hour "lecturettes" on popular subjects in connection with the museum specimens. The first meeting of this kind was occupied by Mr. R. Paden, the deputy-curator, who gave an address on "Fishes" in the Aquarium-room. Mr. G. H. Ball, C.C. (member of the Library, Museum, and Arts Committee) called the attention of the visitors to the improvement in the lighting of the rooms, and expressed the hope that, as the place was rendered more attractive than before, the evening opening of the museum would prove more popular than before. About four hundred people attended on the first night when the building was thrown open to the public this season. At a subsequent meeting Mr. F. P. Marrat, of the museum staff, gave an interesting address on "Cuttle Fishes," dealing with their ancient and modern representatives as illustrated by specimens in the museum cases. The museum is open on Monday evenings from 7 o'clock until 10, and the "lecturette" commences at 8 each evening. No charge is made for admission.

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The fine Natural History Museum at Newcastle-upon-Tyne proved the rendezvous of many scientific celebrities, who found much to praise, both in the arrangement of the building and in the collections displayed there. Geology is especially well represented, the coal-measure fossils being particularly fine. The collection of minerals, too, is probably unsurpassed out of London, if we except the Phillips Collection at Liverpool. Some excellently arranged life-groups of animals enliven the usually dull array of birds and beasts which, in so many museums, encumber the wall cases without the slightest attempt towards artistic arrangement.

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Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between September 16th and October 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S., F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	Highest (September 16th)	30·47	Inches
,, ,,	Lowest (October 7th)	28·82	,,
,, ,,	Mean	29·733	,,
,, ,,	,, for 22 years September	29·915	,,
,, ,,	,, ,, October	29·879	,,
Temperature	Highest (September 18th)	64·7	Deg. F.
,,	Lowest (October 10th)	38·2	,,
,,	Mean	50·4	,,
,,	,, for 22 years September	56·2	,,
,,	,, ,, October	49·3	,,
,,	,, of Evaporation	47·0	,,
,,	,, ,, for 22 years September	52·8	,,
,,	,, ,, October	46·8	,,
(*b*) Rainfall	Amount	3·576	Inches.
,, ,,	,, Mean for 22 years September	3·356	,,
,, ,,	,, ,, October	3·630	,,
,,	Number of Days on which Rain fell	22	
,,	Greatest fall in 24 Hours (September 23rd)	0·458	Inches.
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·0	
,,	,, ,, for 22 years September	6·5	
,,	,, ,, October	7·1	
(*c*) Wind	Velocity, Greatest (October 7th)	81	Miles.
,,	,, Least (October 11th)	1	,,
,,	,, Mean Hourly	18·8	,,
,,	Greatest Pressure on Square Foot (Oct. 7, 9-25 a.m.)	54·4	Pounds.
,,	Direction at time of Greatest Pressure	WSW	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
25	16	106	87	95	210	136	45	0

Notes.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

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Bolton.

The Weather.

September 15 to October 14, 1889.

During the third week of September the fine weather enjoyed during the first fortnight completely broke down, and during the 1st four days heavy rains occurred, accompanied by hail. Barometric pressure fell from 30·47 in. on the 15th to 29·59 in. on the 21st. Temperature varied from 53·5° to 43·7°. The weekly averages were :—Barometric pressure 30·035 in. ; mean temperature, corrected for daily range, 49·52° ; relative humidity 74 % ; total sunshine 24 hours 25 minutes ; rainfall 2·011 in. ; wind variable. From the 22nd to the end of the month the barometer was unsteady, and weather showery. The averages were :—Pressure 29·833 in. ; temperature 47·73° ; humidity 79 % ; total sunshine 30 hours 5 minutes ; rainfall 1·89 in ; wind northerly.

The mean pressure of the month of September, 30·045 in., was above the average, and, although 17 oscillations occurred, the range was only 0·892 in. The mean temperature, 53·11°, although slightly below the average, was higher than in 1888 or 1887. The warmest day, 62°, occurred on the 12th, and the coldest, 43·55°, on the 23rd. The temperature of the soil and water again show an increase of more than one degree over the corresponding month in 1888. Rain fell on 16 days, hail on 3 days, sunshine was recorded on 20 days, and fog occurred on the 26th. The harvesting of cereals was about completed before the weather broke down on the 17th.

The first week of October was humid, with slight fogs on 4 days, very unsettled pressure, the barometer falling from 30·019 in. on the 1st to 28·873 in on the 7th, when a westerly moderate gale of seven hours' duration occurred. At 9 a.m. the anemometer showed the movement of the air to be at the rate of 44 miles per hour. The weekly averages were :—Barometer 29·637 in. ; temperature 47·83° ; humidity 86 % ; total sunshine 5 hours ; rainfall 1·393 in. ; wind variable. From the 8th to the 14th humid weather prevailed, with low pressure. The averages were :—Barometer 29·495 in. ; temperature 44·9° ; humidity 88 % ; total sunshine 12 hours 30 minutes ; rainfall 0·277 in. ; wind westerly and calm.

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The following are the accumulations of growing factors from the 1st January to 14th October for the past 3 years :—

Year.	Growing Temperature.	Rainfall.	Sunshine.
1887	3869·8°.	20·590 in.	1041 hrs. 48 min.
1888	3489·6°.	28·064 ,,	736 ,, 47 ,,
1889	3874·0°.	31·573 ,,	798 ,, 28 ,,

W. W. Midgley, F.R.Met.S.

Met. Observatory, Bolton, October 18, 1889.

Sheffield.

Meteorological Summary.

September, 1889.	Temperature. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for Sept.* Daily Max.	Means for Sept.* Daily Min.	Rainfall. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Sep.* Ins.
Sheffield ...	75°	10th	37°	22d	55°	—	—	1·85	11	0·88	23rd	—
Spurn Head.	74°	11th	42°	21st	55°	—	—	1·24	12	0·36	24th	—
York	74°	10th	33°	20th	54°	63°	47°	0·97	13	0·30	23rd	2·98
Barrow	68°	10th	39°	20th	55°	—	—	3·83	15	0·73	20th	—
Liverpool ...	73°	10th	42°	16th	56°	61°	51°	1·97	16	0·45	23rd	3·56
Holyhead ...	68°	12th	45°	21st	56°	61°	53°	1·83	16	0·58	23rd	3·35
Oxford	80°	11th	35°	16th	56°	64°	49°	1·71	7	0·92	24th	2·91
London	81°	11th	35°	21st	57°	66°	49°	1·61	9	0·76	24th	2·59

* The means of Temperature and Rainfall for September are for 15 years.

September 16 to October 15, 1889.

Pressure.

On September 16th pressure was high. 30·2 in., all over the country, but it had fallen to 30·0 in. on the 17th, and it was still giving way on the 18th, when it ranged from 29·8 in. to 30·0 in. It continued to fall on the 19th, and was down to 29·4 in. in the North and 29·9 in. in the South, and was the same height on the 20th, though inclined to rise. There was very little change on the 21st and 22nd, but a general rise on the 23rd except in the West, where it was falling again. The fall in the West had spread over the kingdom on the 24th, but there was a recovery on the 25th, though the barometer was still rather low, and a depression from the North West on the 26th caused a further fall in that region, but pressure was high in the South East. On the 27th there was little change, and the barometer ranged from 29·8 to 30·1 in., remaining the same on the 28th, but there was a gradual recovery on the 29th. On the 30th pressure was somewhat irregular, rising in the North and falling in the South, the rise extending all over the kingdom on October 1st, when the barometer was above 30·0 in. in most places. It was still high on the 2nd but giving way, and was down to 29·7 in. on the 3rd, falling still lower on the 4th, when there was a depression over the kingdom, with readings down to 29·5 in. The depression remained on the 6th but was passing away to the North, and there was a slight rise. On the 7th another deep depression from the West, with readings down to 28·7 in., was travelling across the country, and on the 8th pressure was very uneven, rising in the East, but falling quickly in the West with close isobars, and continued to give on the 9th, when the readings ranged from 28·7 in. to 29·2 in. On the 10th the barometer though low was steadily rising, and continued to do so on the 11th, when it reached 29·5 in., remaining at this height on the 12th, but rising to 29·8 in. on the 13th and 29·9 in. on the 14th. On the 15th it was again falling in the West, where the readings were 29.7 in., and 29·9 in. in the East.

The Weather.

During the week ending September 21st the weather underwent a decided change, being fine and dry during the first part of the time, but becoming squally and showery, especially in the West, during the latter part of the week. Temperature was low for the season, and on the 20th and 21st the maximum readings were below 60° except in the South, and ground frosts were experienced in the inland parts of England on the 16th and 17th. On the 20th lightning was seen in the East and South East. There was rain on four days at Sheffield, Barrow, and Liverpool, three at Holyhead, London, and Oxford, two at York, and one at Spurn. From the 22nd to the 28th the weather was very variable and unsettled, being sometimes mild, sometimes cold, dull, and wet in the South, and less rainy in the North. The wind shifted to all points of the compass and blew with the force of a gale. Rain fell on six days at Liverpool and Holyhead, five at Spurn and Barrow, four at Sheffield and York, and two at Oxford and London, the amounts at the two last places being large. From September 29th to October 5th the weather continued unsettled and showery, the amounts of rainfall over some parts of England being very large. At Holyhead on the 3rd 1·13 in. of rain fell. Thunderstorms were observed during the latter part of the week in the East and South of England. Temperature was continuously low, and on the night of the 3rd it fell to 32° at Loughborough. Rain fell on six days at London, five at Spurn, Liverpool, and Holyhead, and four at Sheffield, York, Barrow, and Oxford. The following week ending October 12th the weather was again changeable and unsettled, with heavy rain at times and strong gales at the beginning of the week, the gale being unusually severe, especially in the North and West, on the 7th. Temperature differed little from the normal, but slight frosts were experienced over central Scotland on the 8th, and at Oxford and some parts of central England from the 10th to the 12th. Rain fell on six days at Barrow and Holyhead, five at Sheffield, York, Liverpool, and London, four at Spurn, and three at Oxford.

Sun Spots.

From September 16th to 18th the sun was without spots, and again on the 20th. From that date to the 25th the weather was cloudy, but on the latter date the sun was visible, and there was a round spot near the eastern limb and to the South of the disc. On the 27th this was preceded by a smaller spot, and similarly on the 28th, but on the 30th only one spot was visible. On October 2rd there were two spots, which appeared elongated and were both near the Western limb, these probably being the same as appeared as one spot on September 30th. Observations could not again be made till the 8th, when the sun was spotless. On the 9th there were three faint spots midway across the disc from East to West and to the South. These were again visible on the 10th, but no further spots were seen up to October 15th.

E. Howarth, F.R.A.S.

Museum and Observatory, Sheffield, Oct. 20, 1889.

Obituary.

James Prescott Joule.—We regret to have to record the death of Dr. James Prescott Joule, which occured on the 11th October, at the age of 71. He was a pupil of Dalton, and in early life commenced a series of researches and experiments in physical science, in which he greatly distinguished himself. The world owes to him one of the greatest discoveries of the age, viz., the demonstration of the law of mechanical equivalence between work and heat. Some of his more important papers were read before the Royal Society in 1849, and the British Association in 1842 and following years. For his great achievment, the medal of the Royal Society was presented to him in 1852. Since 1872, when his health broke down, shortly after his appointment as president of the Bradford meeting of the British Association (which he was unable to attend), he has been almost entirely an invalid, quietly pursuing his own studies, and but rarely entering the arena of public life.

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A Last Word about the Wirral Runic Stone.

By the Rev. Wilfrid Dallow.

SINCE the second brief notice of this curious sepulchral slab of the 7th century appeared in *Research* for July, further light has been thrown upon its quaint characters, so that its former interpretation is considerably altered. In the opinion of Professor Stephens, of Denmark, and other *savants*, the correct and final solution of the case has probably been now arrived at. The Rev. G. Browne, B.D., Disney Professor of Archæology in the Cambridge University, accompanied by the Dean of Chester, visited the stone last July, and made a minute and careful examination of it. According to the new arrangement of the Runes, they stand thus:—

F O L C Æ = folks, *i.e.*, his kin, or body-guard.
(This word belongs to that class of nouns which in North English make the nominative and accusative plural in O or A, or Æ).

A R E A R D O N = reared, or raised.

B E C V N = a grave-stone, &c.

The two Runes obliterated at the beginning of the second line are probably *g e*, a common Saxon enclitic. Presuming, then, that the first entire Rune is an error of the cutter, and is not a W (as before stated) but a B, we then get:—

G E B I D D A T H = bid ye, or pray ye, imperative.

F O T = for. (The T is an error of the cutter).

A T H E L M U N D = proper name.

(This name seems to be *unique*. We have many compounds of Ethel—as Ethelred, Ethelgiva, &c.; and also of —mund, as Osmund, Edmund, &c. Athelmund means "Royal Peace.")

Here we have an ancient Bidding-stone, or Bid-stone, asking a prayer of the passer-by for the soul of some Saxon warrior, or priest, who lay interred beneath. After a lapse of so many centuries, it is well-nigh impossible to discover whence the stones were procured wherewith the old Church of Overchurch was built, and, therefore, we shall never find out whence this Runic slab was taken, and unrecognised built into the walls. That it was in its day (7th century) an important though rude monument, marking the last resting-place of some great Saxon, there can be but little doubt; and it would, indeed, be curious if it gave its name to the chief hill in the neighbourhood, Bidston Hill, from whose quarries the materials came, likely enough, for building Overchurch. In old documents, we find Bidston Hill spelt variously Bideston, Bydeston, and Bydestone. The Saxon verb biddan, "to bid, ask, pray," enters into many old English words, *e.g.*, bedel, a beadle, one who calls to prayer, a crier; bedesman, one who prays for another. Inside the small but elegant Chantry of Prince Arthur Tudor, in Worcester Cathedral, these "bedesmen" are seen sculptured with their string of *beads* in their hands.

Were this valuable old stone only complete, there would be at least four or five more Runes in each line (as proved in a former article), and these would probably tell us the title or condition of the deceased. By referring to the history of the period, there is reason to believe that Athelmund was a Saxon soldier or officer. About the year 625, Cadwalla, King of Gwynedd (as North Wales was then styled), bearing great hatred towards Edwin, King of Northumbria, led an army against him, and the rivals met near Morpeth. In a fierce battle which followed, Cadwalla was thoroughly beaten, but managed to rally around him sufficient men to beat a safe retreat across the Mersey and the Dee, and so into his Welsh kingdom. Edwin pursued him over hill and dale, and finally beseiged his enemy in Puffin Island, off Anglesey. Now, in the skirmishes which occurred in this retreat of Cadwalla across our Cheshire Wirral, soldiers were likely to fall belonging to either army. If, therefore, Athelmund, in the Saxon ranks of King Edwin, so fell, and departed in that "noble peace" signified by his name, what more natural than that his fellow-comrades, or "body-guard" (as "folcæ" strictly means), should have this Runic epitaph cut, before retiring across the Mersey into the Strathclyde. Northumbria had been but recently evangelized by St. Paulinus, the first Archbishop of York; and thus, to those who can find "sermons in stones," this old and rudely adorned monument proclaims the faith of him who lay beneath, in the touching appeal—"Pray ye for Athelmund."

In conclusion, if it seem to the general reader that undue importance has been given to this Runic "find," it must be remembered that such stones are rare in Europe, and very rare in England; and, owing to their destruction, are not often found in the Northern countries, where they most abounded.

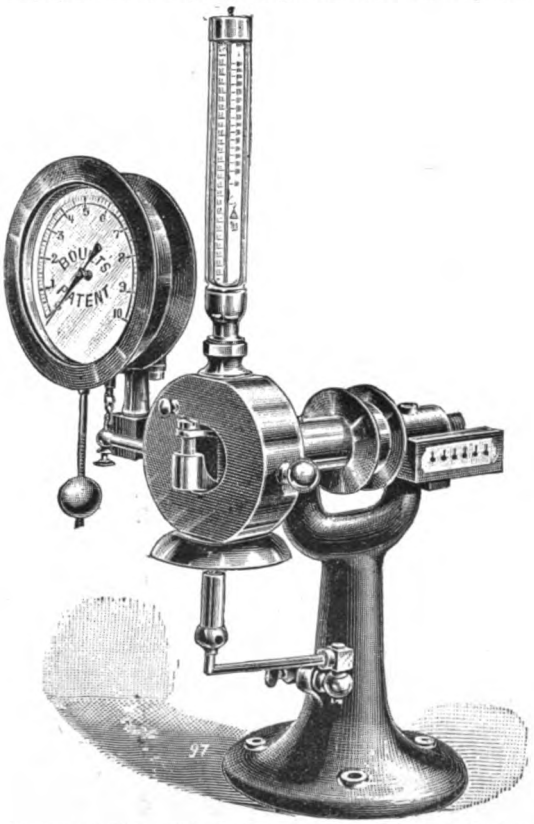
This is the first Runic stone found in Cheshire. A cast has been carefully prepared, and will be presented by the Dean of Chester to the Grosvenor Museum. Papers will shortly be read by Rev. Professor Browne and myself at an early session of the Cheshire Archæological and Historic Society.

Boult's Patent Lubricant Tester

(For Hot or Cold Tests).

THE objects in view in designing this oil tester were:—1st, the possibility of readily maintaining the testing journal at any desired temperature; 2nd, complete retention on the rubbing-surfaces of the oil under test; 3rd, measurement of the friction between the rubbing-surfaces; and, 4th, the application of suitable pressure to the rubbing-surfaces.

Of these desiderata the ruling one undoubtedly was the second, and the object is attained with great simplicity by the use of a complete bush with internal flanges in place of the brasses in other oil testers. This construction necessitated the use of an expanding journal which could be passed through the contracted opening due to the internal flange, and, by means of a spring, be pressed with the required force



against the inner surface of the bush. Accordingly this design has been adopted, with the further modification of being self-centring, so that no other support or guide whatever for the bush is needed, while, owing to the rubbing-surfaces of the journal being at its greatest diameter, the centrifugal force due to rotation assists the flanges on the bush in keeping the oil just where it is wanted.

The regulation of temperature is effected by surrounding the bush with a jacket, which may be filled with a substance easily maintained at the point desired. Thus, for cylinder oils, the jacket may be filled

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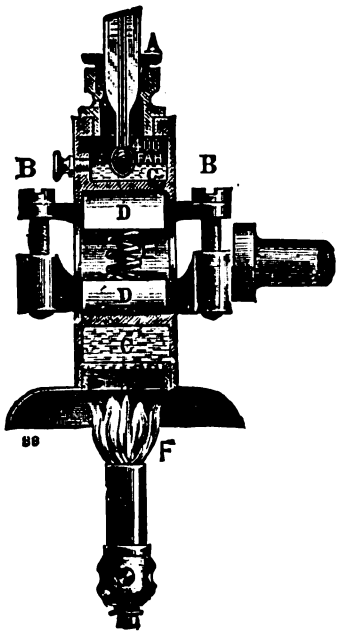
with an oil of high flash-point, and heated by means of the Bunsen burner, with regulating cock fixed below.



A. Thermometer, the scale of which is graduated in degrees Fah., and their equivalent in lbs. pressure (above the atmosphere).
B B. Set screws (employed in compressing Spring E).
C C. Cylindrical hot-oil bath to heat friction surfaces.
D D. Expanding friction journal.
E. Spiral spring expanding D D to make friction.
F. Bunsen burner.

For testing at temperatures lower than that of the surrounding atmosphere the jacket is filled with water or brine, cooled down with ice or otherwise as required. The thermometer on top of the instrument shows the temperature of the contents of the jacket, and, therefore, of the enclosed bush.

Tests with this machine have been made at temperatures ranging up to 450° Fah. The friction is shown on the dial, the readings of which indicate in pounds the absolute friction on the rubbing-surfaces—not the pull of the arm or lever attached to the jacket. The difference of readings of the counter at the beginning and end of a test shows the number of revolutions made, and, as each revolution causes the rubbing-surfaces of the journal to travel eight inches, the number of feet travelled is found by simply deducting from the number of revolutions one-third thereof. The co efficient of friction for each oil is found by dividing the reading on the dial by the pressure of the spring in the journal, or 68 lbs.

In addition to testing cylinder lubricants at the high temperatures re'erred to above, this machine may be used as a viscometer for lubricating oils at temperatures ordinarily met with on journals, &c.

Societies.

Architecture.

Liverpool Architectural Society.—The opening address of the session was delivered on the 7th of October, by the president, Mr. T. Mellard Reade, F.R.I.B.A. The subject for the evening was "Architecture, Ancient and Modern," in which the different conditions governing ancient and modern work were pointed out and contrasted. Mr. Mellard Reade has always been an upholder of a free treatment of architectural details in opposition to the "purist" view, and in his address showed that the tendency of modern architecture had set in this direction, and he considered that the ideas of the best secular architects are insensibly converging towards more settled principles, even through the waves of fashion in style. Further advance would flow from architects attacking the varied problems of modern requirements in a direct and sensible manner, without too much stress being laid on precedent, or too free use of architectural "properties." The new materials within the command of the modern architect, of which steel is an important one, would insensibly react upon the style of our buildings if architects only honestly aimed at conquering structural and other difficulties with artistic ingenuity, adopting the principles of the grand builders of old rather than slavishly copying the external forms of ancient architecture. The modern buildings, like the ancient ones, if we are to rival or surpass them, should result from natural growth, but for good architecture to become general and of every day use the public now, so deficient in artistic sympathies, require educating. In midiæval times, good taste was general and natural to the individual, and, so far as we can judge by the remains left us of the common habitations of the people, not at all confined to the church or the pa'ace. Whether in these days of scientific education a similar agreeable state of things will ever be reached is a problem of the future, but architects should assist all in their power a movement in this direction by thoughtful study and doing their very best in the buildings entrusted them to design and build, acting on the good old principle of example being better than precept.

Biology and Natural History.

Chester Society of Natural Science.—The eighteenth annual *conversazione* was held at Chester Town Hall, on 3rd October, and was as interesting and instructive as it was enjoyable and successful. In the Sessions Court, Mr. G. E. Thompson, of Liverpool, gave an interesting lecture entitled "Rambles along the Riviera," illustrated by lantern slides selected from three hundred photographs taken during the early spring of this year by the lecturer. The large assembly-room was occupied by varied collections of herbaceous flowers, fossils, seabirds' eggs, butterflies and moths, fresh-water aquaria illustrating pond life, specimens of early printing, engraving, &c. The splendid collection of flowering shrubs and sub-shrubs grown in the open air, sent by Mr. A. O. Walker, Nant-y-Glyn, Colwyn Bay, was quite unique, inasmuch as many species of plants not of the hardy nature, such as fuchsias, &c., were shown in full flower, testifying to the mildness of the climate at that part of the North Wales coast. The Council-chamber was set apart for the microscopical exhibition, which this year was particularly fine, reflecting great credit on Mr. T. Shepheard, Mr. T. D. Siddall, Dr. Stolterfoth, and other members of the sub-committee who had charge of the arrangement of this department. Several members of the Liverpool Microscopical Society arranged a series of splendid exhibits. A number of really superior photographs exhibited were the work of members of the recently-formed photographic section of the society. Mr. R. Newstead, the curator of the Grosvenor Museum, had on view a valuable collection illustrative of the fauna of the district. The display of the Kingsley memorial prize collections of diptera and hymenoptera, coleoptera and lichens were exhibited. The prizes given by the society were awarded as follows:—The Kingsley memorial medal, for having contributed materially to the promotion and advancement of some branch or department of natural science, Mr. T. Ruddy; Kingsley memorial prize, for collection of diptera and hymenoptera, terebrantia, &c., Miss Edith C. Tomlin: Kingsley memorial prize, for collection of coleoptera, Mr. W. E. Sharp. Grants from Kingsley memorial fund for the encouragement of scientific research: to Mr. R. Newstead, £5 for the valuable work he has done in the life histories of injurious insects; Mr. A. J. Nixon, 2 guineas for book of notes of observations of the natural history of the Manley and Delamere forest district; Miss Annie E. Siddall and Miss Muriel Broadbent, 2 guineas for collection of lichens. At a largely-attended meeting held in the evening, Professor T. M'Kenny Hughes presided, and there were also on the platform Countess Grosvenor, Mr. George Wyndham, the Mayor and Mayoress, Mr. and Mrs. G. Dutton, and Col. Scotland. The Countess Grosvenor presented the prizes, and was awarded a vote of thanks on the motion of the chairman, seconded by Mr. A. O. Walker. Colonel Scotland, in proposing a vote of thanks to the Mayor for granting the use of the Town Hall, appealed to the audience to contribute towards the fund being raised to enable the committee to erect a building for the archæological section. Owing to better trade, visitors to Eaton had largely increased this season, and the Duke of Westminster had directed that the Grosvenor Museum should this year participate in the fund derived from visitors' fees.

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LEEDS NATURALISTS' CLUB AND SCIENTIFIC ASSOCIATION.—A meeting of this club was held at the Yorkshire College, on the 30th September. Professor L. C. Miall, F.L.S., F.G.S., occupied the chair. A paper was read on "The Structure and Life History of a Fungus," by Mr. Harold Wager, Assistant Lecturer in Biology. The following is a short abstract:—What is meant by a "fungus" will, perhaps, be best explained by considering for a moment the exact place of the group of plants known as the fungi in the vegetable kingdom. As is well known, the vegetable kingdom is divided into five large groups, each of which is composed of plants which resemble each other in certain important particulars, and which can be more less easily separated from the other groups. The highest and most important group is that of the flowering plants; next to these, and distinguished from them by the structure of the reproductive organs, is the fir tree, or cone-bearing group of plants; then we have the fern-like plants, and next to these the moss-like plants; and, lastly, the Thallophytes, or undifferentiated plants. The first four groups agree with each other in forming distinct leaves and stems; the Thallophytes are distinguished from these by never becoming differentiated into such special organs. The Thallophyte group, which is thus easily distinguished from the other groups, is divided into two sub groups, the Algæ and the Fungi, the difference between the two being that the cells of the former contain chlorophyll, whilst the cells of the latter are destitute of it. We may, therefore, roughly define a "fungus" as an undifferentiated plant, the cells of which are destitute of chlorophyll. The special fungus considered here is that which produces the turnip disease, and is known technically as *peronospora parasitica*. It is closely allied to the potato fungus, and, like it, forms white patches upon the leaves, stems, and other organs of cruciferous plants. It is a filamentous form, and its filaments penetrate in all directions between the cells composing the tissues of the host plant. Large globular expansions are formed laterally upon the filament, and penetrate the cells of the plant from which they absorb nutriment. The filament may be looked upon as a single cell containing protoplasm and numerous nuclei. During growth the nuclei undergo changes, distinctly comparable with the complicated changes which take place in the same structures in the higher plants, which lead to their division. The fungus has two methods of reproduction, an asexual and a sexual one. In the asexual method numerous branches are formed, which project through the outer tissues of the host plant into the air, and on these are borne numerous asexual spores or sporangia. The protoplasm contained in each sporangia then divides up and forms numerous smaller spores, which escape when ripe, and by means of two cilia are carried to other host plants, where they settle down and begin to develop. The sexual method of reproduction is full of interest. Male and female organs are developed, often on the same filament, which contain large quantities of protoplasm and numerous nuclei. A number of complicated changes then take place, the significance of which is not yet understood, leading to the rearrangement of the protoplasm and nuclei and the division of the latter, and then later to the formation of a structure, known as the oosphere, or egg. This egg is fertilised by a nucleus from the male organ which passes into it. The oosphere by this means is perfected, and is then known as the oospore or egg spore, which remains in a resting stage, during the winter, and in the following spring or early summer is ready to commence, under favourable conditions, its ravages upon the young host plant with which it may come into contact. This it does either by developing at once into a single new plant, or by forming numerous motile spores, each of which is capable of forming a new plant.

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LIVERPOOL BIOLOGICAL SOCIETY.—The first meeting of the fourth session of this society was held at University College, Liverpool, on Friday, October 11th, the President (Professor W. A. Herdman, D.Sc., F.R.S.E., &c.), in the chair. After the completion of some formal business, including the reading of the report of the council, treasurer's financial statement, and election of office-bearers, His Royal Highness Albert, Prince of Monaco, was, on the proposal of the council, elected as an honorary member. Professor Herdman then delivered his inaugural address on "The Position and Work of a Biological Society, with Suggestions as to Lines of Research in Marine Biology." After thanking the members for electing him for the second year to the office of president, he said that, judging by the energy with which the affairs had been conducted, and the interest and value of its publications as contributions to knowledge, the society might be regarded as having already achieved considerable success. Its proceedings had been accepted by forty of the leading continental societies of natural science in exchange for their own publications, and the establishment of an exchange list during the last session has already led to the placing in the library of 527 books and pamphlets, in exchange for the three volumes of the proceedings. He next proceeded to indicate what further might be done in increasing the number of members, and the attendance at the meetings, and ensuring really good work. He especially recommended the reading of papers which show originality, both in thought and work, in preference to popular expositions of some subject already known to science, but the manner of dealing with the former class of papers, he thought, could be so improved as to make them more generally interesting to the general body of the members. He also advocated one or two addresses each year from investigators from other localities, so as to keep the members in touch with what was being done elsewhere. With regard to investigations to be taken up, he said that by far the most interesting and important researches which require the attention of biologists at the present time were those which have a bearing on the theory of evolution, and, referring to remarks he made in his presidential address of last year, when, in discussing Dr. Romanes' theory of physiological selection, he quoted Professor Fleeming Jenkins' imaginary case of a white man wrecked on an island inhabited by negroes, as an illustration of the swamping effect of free intercrossing of a marked variety of the parent species—the characteristics of the white swamped by intercrossing with the black. He thought that two causes have been ignored, viz., atavism, or reversion to ancestral characters; and the tendency of the members of a variety to breed with one another. He imagined that the numbers of intelligent young mulattoes produced in the second, third, fourth, and few succeeding generations would, to a large extent, intermarry, the result of which would be that a more or less white aristocracy would be formed on the island, including the king and all the chief people, the most intelligent men, and the bravest warriors. Then, atavism might produce, every now and then, a much whiter individual, a reversal to the characteristics of the ancestral European, who, by being highly thought of in the whitish aristocracy, would have considerable influence on the colour and other characteristics of the next generation. Now, such a white aristocracy would be in precisely the same circumstances as a favourable variety competing with its parent species, &c. He, therefore, was much pleased when, a few months after the delivery of his address, he accidentally found in a letter written by the celebrated African traveller, Dr. David Livingstone, to Lord Granville, and dated "Unyanyembe, Central Africa, July 1, 1872," the following passage:—"About five generations ago a white man came to the highlands of Basango, which are in a line east of the watershed. He had six attendants, who all died, and eventually their headman, called Charura, was elected chief by the Basango. In the third generation he had sixty able-bodied spearmen as lineal descendants. This implies an equal number of the other sex. They are very light in colour and easily known, as no one is allowed to wear coral beads such as Charura brought except the royal family. A book he brought was lost only lately. The interest of this case lies in its connection with Mr. Darwin's celebrated theory on the "Origin of Species," for it shows that

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an improved variety, as we whites modestly call ourselves, is not so liable to be swamped by numbers as some have thought." Professor Herdman pointed out that here was a perfect fulfilment of what he said last year, in ignorance of this observation of Livingstone's, predicted as being likely to occur in such a case, viz.: the whitish aristocracy in a dominant condition, and evidently in a fair way to spread their characteristics over a large area and give rise to a marked variety; and it had clearly struck Livingstone fourteen years before the theory of physiological selection had been heard of just as it must strike us now, as an instance telling strongly against the "swamping" argument as used by Fleeming Jenkin and Romanes. Dr. Herdman then went on to say that two discussions that took place at the last meeting of the British Association might be noted as indicating further work for biologists. The first of these was the vexed question of acquired characters. Can a character acquired during the life time of one generation be transmitted by heredity to the next generation? Nearly all evolutionists hold by some form of the Weismannian theory of heredity, and, according to Weismann, it is theoretically impossible for an acquired character to be inherited, because the body of the new individual is formed from germ-plasma which is derived from the germ-plasma of the parent, and has nothing to do with the parent's body which was distinguished by the acquired characters, except that it lay in that body. But if any day an experimental biologist should be able to prove that a single acquired character had been transmitted to the offspring—and Mr. Francis Galton has just suggested some experiments which seem practicable and very suitable for settling the question, and which might give some very positive result—then that one fact would outweigh any amount of theory, and it would be necessary for us to revise our ideas in regard to heredity. Consequently it would be very satisfactory to those biologists who are inclined to accept Weismann's theory of the continuity of the germ-plasma, but, at the same time, would admit the possibility of acquired character being sometimes transmitted, if a loop-hole could be found in the theory which would allow of the germ-plasma being impressed by an acquired character, and for his own part he did not see any great difficulty in the way. At any rate, he said, there seems enough doubt here to allow of a loop-hole in the "continuity" theory, whereby an acquired character might leave its impress upon the germ-plasma, and so be transmitted to the next generation. The second discussion was upon the utility or indifference of specific characters—that is, are the characters by which allied species differ from one another of such a nature as to be actually useful to their possessors, or are they so trivial as not to effect in any way the welfare of the species? This subject opens up a wide field for original research, dealing as it does with the characters, both physical and physiological, of all animals, and seeking an explanation of all modifications of structure and habit. The solution of this wide question in regard to specific characters can only be settled, he held, by an appeal to facts. Competent observers—specialists in the various groups of plants and animals—who are intimately acquainted with the various species must investigate a number of allied forms, not as museum specimens only but in a state of nature, and must observe their habits carefully in order to determine whether there is any relation between the characters by which the species differ from one another, and the observed mode of life. This work, if properly carried out, will lead to a careful revision of the specific characters of allied forms in many groups of animals, in itself a very desirable object, for all specialists know how much the specific characters of some groups are in need of revision. But great care must be taken in this inquiry that the true generic and specific characters are dealt with. Professor Herdman further said that one of the very best fields for investigation of this nature lies amongst the marine invertebrata. Most writers upon evolution, following the example of Darwin and Wallace, have taken their examples from the higher animals—generally from the mammals and the birds, with the addition of insects. Consequently, most groups of the invertebrata still present a virgin field for this department of evolutionary study, to which the name *bionomics* has been applied. During the last couple of years, he himself had commenced some observations on the diagnostic characters of Nudibranchiata, Mollusca, and Tunicata, and he then proceeded to give some examples from these groups in support of his views, and illustrated his remarks by reference to numerous diagrams. He concluded by saying that, although he was only on the threshold of the inquiry, the few instances given were sufficient to lead him to believe that the specific and generic and other diagnostic characters are of actual importance to their possessors—are, in fact, such adaptive modifications as would be produced by natural selection, and therefore he had no hesitation in recommending the subject as one of the most interesting and fruitful for investigation in the whole field of marine biology.

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Liverpool Naturalists' Field Club.—The tenth field-meeting of this club for the season was held on Saturday, 21st September, in Knowsley Park. By the courtesy of Mr. G. C. Hale and Lieut.-Colonel Wyatt, permission was obtained from the Earl of Sefton and the Earl of Derby to drive through Croxteth Park, and enter Knowsley Park by the Croxteth Lodge. On alighting from the waggonettes at the "stand" in Knowsley Park, the botanists were soon actively engaged in the work set out for the day, whilst others wandered down to view the Hall and ornamental portion of the grounds. Special attention was directed to the collecting of fungi, and in all about 40 different species were gathered, the most notable being *Polyporus intybaceus*, very rare and beautiful; *Polyporus elegans*, not common; *Agaricus amanita rubescens*, one of the most beautiful of the mushroom tribe; *Agaricus hygrophorus psitticinus*, named from the parrot-like colours it assumes. From the park the party were conveyed in the waggonettes to Knowsley Village, where tea was provided in the school-room, the use of which was kindly granted by the Vicar, the Rev. J. Richardson, M.A. The prizes for the day were as follows:—Special prize, best collection of fungi, Mrs. E. M. Wood (28 species); best basket of wild flowers, Miss Frances Clementson. The botanical enigma was solved and the plant (*Rumex obtusifolius*) found by Mrs. Waugh, Mrs. Bodell, Mrs. Edwin Davies, Miss E. M. Wood, Miss E. Jee, Mr. C. F. Webb, and Mr. Martin Schneider.—The last out-door meeting of this season was held at the historic city of Chester, on Saturday, October 5th. About 70 members and friends attended, and left Birkenhead by the 1.40 train. The usual field-work was dispensed with on this occasion, and gave place to archæology and history, these two subjects having an eloquent exponent in Mr. J. J. Fitzpatrick, who acted as guide for the day. The ancient Church of St. John was first visited, and while viewing the exterior of this imposing structure a concise and highly interesting account was given of its foundation early in the 7th century, and many historical incidents connected with it since. The Cathedral, the city walls, and the several towers thereon, the Roman Hypocaust, the ancient palace of the Stanleys of Alderley, &c., each was the theme of a special address. Tea-dinner was provided at the Grosvenor Hotel, and afterwards a visit was paid to the Grosvenor Museum, where the party were met by a member of the museum committee, who, with the curator, pointed out and explained the principal objects of interest in the various collections. This museum is particularly rich in Roman remains, for the most part obtained from excavations in the city itself, and these attracted a great amount of attention. The building has only been open about three years, and already more space is required for the proper exhibition of the contents.

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Manx Natural History and Antiquarian Society.—On the 28th September an excursion was held at Sulby, under the leader-

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ship of Dr. Tellet. The "Giants' Grave" and an ancient burial mound near Killabragga were visited, the latter of which is shortly to be carefully explored. After the excursion a short meeting was held, at which Dr. Royle read some "Notes on King Orry's Grave," and Mr. P. M. C. Kermode exhibited the contents of the crop of a sand-grouse shot in Ramsey last January, which consisted of seeds of dock about three species, atriplex three species, vetch, mustard, including, probably, brassica monensis, polygonum, pimpernel, gorn, four seeds of grass, and a considerable quantity of sand, showing that these peculiar and beautiful birds, so far as food is concerned, might live here the year round, and that they would be helpful rather than hurtful to the farmers. Mr Kermode also read a paper on "Some Shells Found in the Boulder Clay and Sand at North Ramsey." Among wild plants in flower observed during the day's ramble were :—Cushag, gorn, heath, heather, harebell, thyme, dandelion, daisy, eyebright, tormentil, plaintain, lousewort, chickweed, self heal, field pansy, sneeze-wort, cornmarigold—white and yellow, silver weed, upright S. John's wort, yellow bedstraw, marsh valerian, cranesbill, scabious, and agrimony. Asphodel in seed was found in abundance, and pinguinula near Killabragga. Miss Travis was fortunate in finding a magnificent bunch of white heather. Of noticeable ferns the oreopteris was plentiful, and it is in all the Manx mountain glens; stunted osmunda was found, and a clump of beech fern near by the mountain streamlets. At a subsequent meeting of this society, a communication from Rev. W. Spiers, F.G.S., &c., was handed in relating to flints from Port St. Mary. Mr. W. S. Baily sent some notes on birds observed by him during August and September, including the rare ruff or reeve, of which a young one was shot on the 10th August, at Ronaldsway, while feeding at a fresh-water pond. Miss G. Crellin presented to the library a copy of *The Land and Fresh-Water Shells of the British Isles*, with illustrations of every species, by R. Rimmer, F.L S., for which the thanks of the society were expressed by the chairman. Mr. Kermode exhibited a fine specimen of a stone celt found in the Lezayre Curraghs, also a large collection of flints and a portion of cinerary urn found by him on the Brooghs, North Ramsey—which he now presented to the museum. The flints comprised cores, chips, flakes, scrapers, and drills or borers. Many were calcined. At the writer's suggestion his paper on the subject was taken as read, and having handed round and explained the peculiarities of the flint implements, he conducted those members who were able to go to the cutting on the Grove Mount Estate where the discovery had been made. A good specimen of a drill was at once picked up by Miss G. Crellin, and, in a short time, a number of flakes cores, chips, and drills were found and handed over to the secretary to be added to his collection in the society's museum.

SHEFFIELD NATURALISTS' CLUB.—The first meeting of this club after the summer excursions was held on October 7th, when the Rev. E. M. Cole, M.A., delivered a lecture on the "Geology of Yorkshire." By means of maps and sections prepared by the lecturer, Mr. Cole very clearly explained the chief geological features of the county, which are of an extremely interesting nature. Facing north from Sheffield all the primary rocks are to the left, or west, and the secondaries to the east, the two periods being separated by the Vale of York. In the N.W. at Ingleboro', Fountain Fell, and at Houghton in Ribblesdale the Silurian crops out, and, travelling in a south-easterly direction, the geologist can trace all the other primary and secondary rocks in succession. Mr. Cole called particular attention to the great thickness of the carboniferous limestone, and described its formation and organic constitution; as also the formation of the interesting caves at Ingleboro', and entered into some details of the rare fossiliferous bed in the millstone grit at Harrogate. By means of an ingenious diagram, Mr. Cole showed how the magnesian limestone comes to lie unconformably on the millstone grit and coal, and showed that while at some places workable coal was thus found under the magnesian limestone, at other places not far distant the coal bed had thinned out, and revealed only millstone grit. The lecture was of a highly instructive character to all field geologists.

Geology.

GEOLOGICAL SOCIETY OF GLASGOW.—At the concluding meeting of the 31st session several interesting exhibits of minerals were shown by Mr. D. C. Glen, F.G.S., and of foraminifera from the chalk of the North of Ireland by Mr. J. Howat. Mr. John Young, F.G.S., read a paper on "The Occurence of Spines within Spines on the Shells of the Carboniferous Productidæ," stating that, though long familiar with the spines themselves, it was only recently he had discovered the peculiar structure he now wished to describe. He pointed out that the spines of the Productidæ were tubular, and referred to the very varied opinions expressed by those palæontologists who had previously taken up the group for investigation as to what they believed were the functions of these spines. Mr. Young said he had now discovered that, within the tubes of the spines of at least four species, there existed a barrier of small spines of microscopic size placed in the tubes just above the junction of the spines with the shell itself. These small spines were planted deeply within the walls of the large spines, and radiated to the centre of the tubes, varying from 20 to 40 or more in number. He was inclined to believe that the detection of these minute spines favours the view held by De Verneuil, one of the authors he had quoted, who held that the spines themselves conveyed water to the interior of the shell, and that, therefore, the small spines existed for the purpose of preventing impurities, or small organisms hostile to the well-being of the mollusc, from passing through with the water to the interior of the shell.—The first meeting of the 32nd session was held on the 10th October, Mr. Daniel M'Millan, vice-president, in the chair. Mr. John Young, F.G.S., exhibited a fine series of specimens of Polyzoa and Monticulipora, comprising over 20 species, which he had this summer discovered at Kirktonholm, East Kilbride. Mr. Joseph Summerville, V.P., exhibited a beautiful crystal of quartz, containing a cavity holding fluid, from the calciferous sandstone of New York State, U.S. Such specimens are geologically of great interest, and remarks on the subject were made by Mr. John Young, F.G.S., Mr. James Thompson, F.G.S., Mr. R. Dunlop, and other members. The hon. secretary (Mr. James Barclay Murdoch) read, on behalf of Mr. James Bennie, of the Geological Survey of Scotland, a paper, entitled "Things New and Old from the Ancient Lake of Cowdenglen." Up to 1867 the picturesque little valley of Cowden, beyond Crofthead, on the road to Ayrshire, was not known to possess any features of special geological interest, but in that year, having been chosen as the route of the direct railway to Kilmarnock, it was invaded by the navvy with pick and shovel, to the utter destruction of all its natural beauties. The gradients being steep the excavations were extensive, and at one point the bed of an ancient lake was cut through, containing deposits of mud and peat lying between two distinct layers of boulder clay. These stratified deposits were found to contain numerous remains of animal and vegetable life, both of higher and lower forms, and as their presence afforded strong evidence of the great ice age, a controversy arose between the upholders of the theory of a single glacial period and those who believed in two or more. Mr. Bennie, who was at that date resident in Glasgow, gave the subject special attention, as did many other field-workers, Mr. (now Professor) James Geikie, Mr. Robert Craig, the late Mr. James Mahony, and others. Numerous papers resulted, but after a heated controversy the subject passed into the limbo of oblivion. Of late years there has been a revival of interest in old lake deposits, which led the author to re-examine the subject and the specimens of the deposits in his possession, resulting in a largely-extended list of the contained organisms. Always a supporter of the "interglacial" or successive theory of ice periods, he re-stated his case in the present paper, bringing forward a fresh

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accumulation of proof. At the close of the paper there was an animated discussion, taken part in by Messrs. John Young, James Thompson, Dugald Bell, James Anderson, and others. The paper was illustrated by an Ordnance map of the district, coloured to show the old lake bed, and by numerous specimens of animal and vegetable remains, some of the minute forms being shown under the society's microscope.

LIVERPOOL GEOLOGICAL SOCIETY.—The annual meeting was held on 8th October, at the Royal Institution, Colquitt-street, the president (Mr. H. C. Beasley) in the chair. Mr. H. Ashton Hill, C.E., was elected a member of the society. The hon. treasurer (Mr. E. M. Hance) presented his annual statement of accounts, showing a balance in favour of the society. The election of officers and council for the ensuing session took place, with the following result:—President, Dr. C. Ricketts, F.G.S.; vice-president, Mr. E. Dickson, F.G.S.; treasurer, Mr. E. M. Hance, LL.B.; librarian, Mr. J. J. Fitzpatrick; secretary, Mr. W. Hewitt, B.Sc.; and members of council, Mr. T. Goffey, Mr. J. Lomas, Assoc. N.S.S.; Mr. G. H. Morton, F.G.S., Mr. T. Mellard Reade, C.E., F.G.S., and Mr. O. W. Jeffs. The retiring president, Mr. H. C. Beasley, then read his annual address, in which he referred to the loss the society had sustained in the death of the late Sir James Picton, amongst whose last labours was the preparation of two papers for the society. He then touched briefly on the cheirotherium footprints so long known in this district, and their probable connection with the labyrinthodon, and he then referred to the remains of this amphibian found in Warwickshire—the magnificent series of which is in the Warwick Museum—and gave some account of the strata in which they were found, and the more important papers bearing upon them. The remains more recently discovered near Sidmouth were also described. The *reptilia* were then dealt with in the same way, those found at Elgin and Bristol, and the *Rhynchosaurus* remains at Shrewsbury being more particularly referred to. The fishes followed, and the finds at Nottingham and Shrewly (Warwickshire) were described, and a series of fish remains from the neighbourhood of Taunton, now in the Bath Museum, were also mentioned. After referring to the little crustacean, *Estheria minuta*, as being the fossil perhaps more frequently met with in the Triassic rocks (though apparently absent in this district), and the great rarity of the *Mollusca*, the author passed to the plant remains so far discovered, which are so fragmentary and imperfectly preserved that our knowledge of the Triassic flora of this country is more limited than that of its fauna. In most cases the author indicated the collection in which the fossils mentioned were now to be found. His own observation led him to think that, as a rule, organic remains in the Trias were formed in places where there was evidence of the presence of water more free than usual from chemical impurity, and that it would only be in places where this was the case that we could expect animal and vegetable life to flourish. He further suggested the probability that these areas would be of limited extent, and would, from time to time, shift their position. The address was illustrated by specimens kindly exhibited by Mr. G. H. Morton, F.G.S., Dr. Ricketts, F.G.S., and others, as well as from the author's own collection.

LIVERPOOL GEOLOGICAL ASSOCIATION.—The annual general meeting was held on the 7th October, at the Free Library, William Brown Street, Mr. A. Norman Tate, F.G.S., &c., in the chair. The annual report and treasurer's statement were satisfactory. Mr. Tate was re-elected president, Mr. T. R. Connell vice-president, Mr. James Hornell treasurer, Mr. I. E. George secretary, and the Rev. S. Gasking, B.A., F.G.S., and Messrs. F. S. Hunt, C. E. Miles, W. H. Miles, and J. Brown were elected as other members of the council. The president afterwards delivered a brief address on "Some Points in Chemical Geology," in which he referred more especially to the influence of organic matter on the mineral constituents of various strata in altering chemical composition, determining deposition at certain points, and giving indication of change which different deposits have undergone.

Microscopy.

BATH MICROSCOPICAL SOCIETY.—The first meeting of the thirty-second session was held at the Mineral Water Hospital, on the 1st October. The treasurer presented a satisfactory balance sheet for the past session, and the secretary read the report of the committee, which stated that, although the past session could not lay claim to such special interest as that of 1888 and 1889, when the *soirée* given by this society to the British Association distinguished its record, the papers which had been read have been of interest and value. The president's address, given on October 2nd, was followed on successive meetings by the papers of Mr. H. C. A. Vine, on "Nutritive Processes in Saccharomyces;" Colonel Blathwayt, on "Some Common Species of Gamasidæ;" Mr. C. Fleming, on "The Histology of Nerves;" Mr. W. S. Walker, on "The Histology of Muscle;" Rev. J. E. Vize, M.A., on "The Genus Puccinia Amongst Fungi." On two occasions photographic and other illustrations of microscopical objects upon the screen diversified the proceedings. On the ladies' night these were successfully undertaken by Messrs. Braham and Gillo, and on December 4th, by Mr. Pumphrey. In March last the society received with regret the resignation of their secretary, Mr. R. H. Moore, who, since 1876, had discharged the duties of his office with advantage to the society. The society now consisted of 9 honorary and 39 ordinary members. The new president, Mr. W. G. Wheatcroft, delivered the annual address, in which he referred to the importance of a study of cryptoganic botany, and also dealt with the doctrine of evolution in relation to the ancient life history of the earth, and to the valuable work that might be done by microscopical societies. The following officers for the ensuing year were appointed, namely:—President-elect, Mr. J. H. Wilson; vice-presidents, Mr. P. Braham and Mr. R. H. Moore; hon. treasurer, Mr. R. H. Moore; hon secretary, Mr. E. J. Hunt; librarian and curator, Mr. H. Hillier. Mr. J. W. Morris and Mr. Cannings Collins were elected by ballot to form with the officers of the society the committee of management.

BIRKENHEAD LITERARY AND SCIENTIFIC SOCIETY.—The first meeting of the thirty-third session of this society was held on October 14th in the Music Hall, Claughton Road, the president, Mr. Wm. Oelrichs, F.R.Met.Soc., in the chair. Several new members were elected, and the president then delivered his inaugural address, entitled "An Introduction to Microscopical Study," in which he pointed out the great advantages to be derived from the use of the microscope, and then went on to give many examples of the information it afforded with regard to plant and animal life, illustrating his remarks with many lantern pictures. This society has, during its long existence, cultivated more especially its literary side, but, judging from the excellent attendance at the opening meeting, and close attention of those present to the address, and other indications, scientific papers and discussions will add greatly to its strength; and the new president's address was certainly of a character to woo to science studies many who have hitherto done nothing or little in that direction.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—On September 23rd Mr. H. Hawkes exhibited under the microscope preparations of *Erica tetralix* and *E. vulgaris*, showing pollen, glandular hairs, and pouch-like anthers. Mr. J. Collins, *Chætophora endiviæfolia*, a fresh-water alga from Sutton Park. Mr. Parker, cyclosis in *Nitella translucens*. On September 30th Mr. P. T. Deakin exhibited specimens of *Typhis pungens* and other shells from the eocene formation of

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Barton Cliff. Mr. J. Madison, a short-spired variety of *Limnæa stagnalis* from Milford. Under the microscope Mr. H. Hawkes showed a rare seaweed, *Naccaria Wigghii*, and a section through a flower bud of horse chesnut. On October 7th Mr. J. W. Neville exhibited a number of specimens of "coal balls," and also sections of the same showing fossil plant structure, notably transverse sections of fern stems, *Rachiopteris Oldhamium*. Mr. J. Madison, slabs from the Keuper Marls of the Birmingham district, showing ripple marks and rain drops, also the fossil wing of a *Neuropterous* insect from the Rhaetic beds, Knowle. Mr. Lassita, a series of *Silurian* fossils from Aldridge. Mr. T. H. Waller, B.A., B.Sc., specimen of band of *Diorite*, showing the line of contact with the Stockingford shale from Nuneaton. Mr. J. Mone, a section of coral, *Cyathophyllum reticulatum*. Mr. H. Hawkes, rattle of the rattlesnake, also the following fungi, *Nectria cinnabarina*, *Peziza cyathoidea*, and a mould on *Trichia varia*. Mr. Camm, *Alivisia intermedia* and *Hemiarcyria*. On October 14th Mr. H. Hawkes showed a remarkable instance of fasciation in the stem of asparagus. A paper was then read by Mr. J. W. Neville, "Notes on the Ovipositors of Insects," which dealt more especially with the deposition of the egg and the apparatus used in the process. The writer then reviewed the various orders of insects, giving the results of his observations in each. Of all the orders the hymenoptera gave the most instances of highly specialized organs. The writer concluded the paper by inquiring why an insect bestowed such unusual care in the deposition and arrangement of its eggs. In the higher orders of animals it was a small matter how the young came into the world, for from the outset of life they had parental care that watched over them with devotion and self-sacrifice. The insect world had nothing of this, few, indeed, ever seeing their own offspring. Consequently the last act of their lives was to deposit their eggs in a secure spot on or near to the necessary food plant, in the full hope that beneficent sunshine will wake them to life, and that untended and unfriended they may fight the battle of life, and transmit to another generation their parents' gift to them. The paper was illustrated by a series of drawings.

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LIVERPOOL MICROSCOPICAL SOCIETY.—The sixth ordinary meeting of the twenty-first session was held at the Royal Institution, on the 4th October, Mr. Isaac C. Thompson, F.L.S., F R.M.S., in the chair. Mr. Thompson was elected president for another year, to take office in January next. Mr. W. H. Read read an interesting paper upon the "Fresh Water Mussel" (*Anodonta cygnea*). After showing its position in the geological strata, as illustrated by fossil remains, and its place in the animal kingdom, he described with minuteness the peculiarities of bivalve molluscs and the nomenclature of the exoskeleton in this and other kindred molluscs. The enormous length to which the siphonal tubes may in some cases be increased to was shown by means of the Mediterranean *Sanguinolaria*. Coming to the mussel, he pointed out the rudimentary nature of its siphons, and explained the markings on the interior of the valves. This led to a description of the appearance of the animal, with its morphology and physiology. The alimentary, respiratory, vascular, excretory, and nervous systems were then worked out. The paper concluded with a brief account of the reproduction of the animal and the peculiarity of the specialised form of the embryo, as fitting it for transportation. The whole was illustrated by means of hand-sketched lantern slides, prepared by Mr. Read. The various organs and tissues had their names clearly written out, thus affording a most convenient method of following the paper. A discussion followed, in which several members took part, after which the usual *conversazione* was held.

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MANCHESTER MICROSCOPICAL SOCIETY.—The annual exhibition and *conversazione* of the Manchester Microscopical Society took place at the Grand Hotel, Aytoun-street, and brought together a large company of members and visitors. Four rooms were taken up by the collection of microscopes, under which were shown many interesting objects. These were contributed by prominent members of the society. Practical demonstrations in the preparation and mounting of objects for the microscope were given by Messrs. Mark L. Sykes, W. Chaffers, George Wilks, and H. Jones. Mr. E. Ward, F.R.M.S., exhibited a series of eighty-four slides illustrative of scenes along the Ship Canal. They showed very clearly the nature of the engineering work, kind of people employed, and the scenery through which the Canal passes. Two new members of the society were elected, the total number on the books being now 232. Professor Milnes Marshall, the president, was in the chair, and during the evening he made a presentation, on behalf of the members, to Mr. George Wilks, the late secretary of the society, whose place has been taken by Mr. James Hart, F.C.S. Mr. Wilks is an ardent microscopical student, and has done splendid work for the society during the past six years, especially in connection with the Mounting Section. The evening's programme also included an address by Mr. Thomas Hicks, B.A., demonstrator in botany at Owens College, on the mechanical tissues of plants, the subject being illustrated by twenty microscopic slides. He explained that the mechanical tissues of plants are those which give strength and support to the various organs, and enable them to bear the mechanical strain and tension which play upon them.

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SOUTH LONDON MICROSCOPICAL AND NATURAL HISTORY CLUB.—The opening of the fourteenth session of this club—one of the most flourishing and useful suburban societies of its class—was celebrated on the 2nd October by a *conversazione* held at Brixton Hall, Acre Lane, S.W. In the large hall between thirty and forty microscopes, lent by members and friends, were on view, and there were also exhibited diagrams, shown by Professor Stewart and Messrs. J. Groves, F.L.S. (hon. sec.), Holmes, Suffolk, and W. West; a very complete series of flint implements from the borders of Norfolk and Suffolk, by Mr. R. Elliott; skins of mammalia and birds, by Mr. W. E. Dawes; Pleistocene mammalian remains and fossil fish remains, also recent and fossil mollusca, by Mr. T. Leighton; lepidoptera, by Messrs. R. Adkin, F.E.S., H. W. Barker, and J. R. Wellman; numerous cases of coleoptera, diptera, &c., Mr. T. R. Billups, F.E.S.; echinodermata, by Mr. T. D. Russell; British mosses, by Dr. R. Braithwaite, F.L.S.; British sea-weeds, by Mr. E. M. Holmes, F.L.S.; and seeds, by Mr. T. Sebastian Davis, F.C.S. A popular feature of the meeting was the display at intervals during the evening of a series of photo-micrographs and other natural-history slides, and a number of specimens of pond life, exhibited by means of the excellent oxy-hydrogen lantern recently purchased for the club for this purpose.

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Photography.

PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN.—The annual exhibition of this society was held in the rooms of the Royal Society of Painters in Water Colours. In every respect the exhibition equals those of previous years, affording an interesting insight into the progress of the photographic art alike from the point of view of the amateur and the professional. A well-diversified collection of pictures was shown, together with a goodly array of apparatus and appliances. In each section the latest discoveries were brought to the front, and forcibly illustrated the improvements in method which characterise the advance of the photographic art.

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LIVERPOOL AMATEUR PHOTOGRAPHIC ASSOCIATION.—The 258th meeting was held on the 26th Sept., at the Association's Rooms, Lord-street, Mr. A. W. Beer in the chair. The president drew the attention of members to the arrangement respecting the competition prints and lantern slides, and announced that the following gentlemen had kindly undertaken the duties of adjudicating and awarding the prize

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medals offered by the association, viz. :—Mr. Geo. W. Webster, Mr. John Finnie, and Mr. E. R. Dibdin for prints and enlargements; and Mr. Geo. E. Thompson, Mr. E. L. Grundy, and Mr. Paul Langé for lantern slides. Mr. Forrest submitted an Eastman bromide print developed by hydrokinone, the result being very favourable. Also a specimen lantern slide upon Carbutt's celluloid film, claiming for the latter adaptability for the purpose in every way. Subsequently, Mr. Geo. E. Thompson gave his lecture, entitled "Rambles along the Riviera, from Marseilles to Genoa," the result of a three weeks' visit in February last. The slides were quite up to the high level of artistic excellence attained by him in "Up the Mediterranean," "Sunny Italy," and "The Waterways of Holland."

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Newcastle and Northern Counties Photographic Association.—A lantern slide exhibition, in connection with a competition recently held by the association, was given on October 9th, in the lecture-room of the Literary and Philosophical Society, Newcastle. There was so large an attendance that there was not a vacant seat in the hall. Mr. Gibson presided, and apologised for the absence of their president, Mr. Alexander Stevenson. Recently, he said, a competition for lantern slides was held, and four medals were offered as awards—a silver and bronze medal, for not less than 24 slides, open to all professionals and amateurs in the world; and a silver and bronze medal, for not more than 12 slides, confined to amateur members of their association. In the open class the silver medal was won by Mr. John W. Wade, Manchester, and the bronze medal by Mr. Cyril Frith, Reigate; and, in the members' competion, the silver medal was obtained by Mr. Edgar G Lee, Cullercoats, and the bronze medal by Mr. Henry R. Procter, of Tynemouth. Mr. Gibson delivered an interesting address on the uses of photography, after which some two hundred of the competition slides were exhibited by means of the optical lime-light lantern.

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General Science, Literature, &c.

Liverpool Literary and Philosophical Society.—The annual business meeting of the above-named society was held at the Royal Institution, Colquitt-street, on the 7th October. The retiring president, Mr. James Birchall, occupied the chair. Mr. John Rutherford, the hon. secretary, presented the annual report, in which the council of the society congratulated the members on the unmistakable proofs of the society's vigour and progress during the year. The members, after some further formal business, adjourned to the Lecture Theatre, where the Rev. H. H. Higgins, the president-elect, delivered his inaugural address, the subject being "What is Religion?" Religion, he said, in common with other great natural gifts of the Eternal, had this quality—its benefits were enjoyed by multitudes who were quite incapable of describing the origin of their happiness therein. Much of what was often taken for religion was more commonly its adversary; but that, as was seen in the judgment parable, those who were unconscious of any specially religious motive might possibly be genuinely under active religious influence. The first, and perhaps the most stupendous, fact calling for their notice was the existence of fourteen hundred millions of mankind now living on the earth. All those, with the exception of a very small residue, were worshippers, and had some kind of religion. In reply to the momentous question, "What is Religion?" he had attempted to regard the subject synthetically. Passing on to notice a few of the great religions of the world, he referred first, to Brahmanism; secondly, Buddhism; thirdly, Confucianism; and fourthly, to the religion of Zoroaster. He afterwards proceeded to refer to natural religion, and said it was probable that natural religion owed much of its discouragement to prejudice against its name. He did not extenuate the evil of unreasonable contempt for the teachings of nature in spiritual things; but it seemed probable that tens of thousands of good men desired to have, in public worship and in their lives, a reverential awe and a genuine gladness they could not have without there was, in worship and in life, a substructure of natural religion.

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The Library Association.—The twelfth annual meeting of this association took place at Gray's Inn, London, on October 2nd, 3rd, and 4th, under the presidency of Chancellor Christie, of Manchester. There were over two hundred members present, the attendance being one of the largest on record. The president's address was of a practical character and dealt with the qualifications of the librarian; he also discussed cataloguing, shelf arrangement, and various other important matters with which librarians have to deal. Mr. Melvil Dewey, of the New York States Library, inventor of the Dewey System of Shelf Classification, and Principal of the American College for Librarians, spoke on the subject of libraries, dividing them under four heads, and exhibited draft of a portion of the Laws of New York State, which recognized the library as the people's university, showing in a forcible manner the difference in the status of libraries and librarians in the two countries. The librarian of the British Museum impressed upon provincial members the urgent necessity for collecting, each in his own district, the local records, such even as parish registers, and recommended the preservation of store copies of such local works as are in great demand. Mr. Blades (the great authority on early printed books) then discoursed on Chained Books. The remainder of the first day was spent in visits to Mercer's and Merchant Taylor's Halls, finishing in the evening with a *conversazione* at Stationers' Hall. At the commencement of the second day's proceedings the president announced that Sir John Lubbock and himself had awarded the £10 prize for the best attempt at a consolidated Free Library and Museum Bill to Mr. J. J. Ogle, of the Bootle Free Library, in conjunction with Mr. Fovarque, the deputy town clerk of the same borough. The meeting then discussed the provisions of this Bill, almost the first really earnest and praiseworthy attempt to bring that complicated mass of confusion, the Free Library Acts, with their numerous amendments, into something like manageable limits and condition. The association, while fully recognising its value and importance, considered it undesirable that the Bill should go forth with their imprimatur, but wished it to be considered as a prize essay only, to be circulated among librarians and others engaged in the work and management of free libraries and museums, with a view to elicit further ideas and suggestions. Mr. Thomas, one of the honorary secretaries, followed with a paper on "The Free Library Movement in London," referring to which a metropolitan critic says, "The paper consisted of a history of the movement, a subject with which, we should have thought, the librarians present were almost as well acquainted as himself." Mr. Lancaster, of the St. Helens Library, read a paper on "Free Libraries and Technical Education," a subject which is coming to the front very rapidly, more especially since the passing of the Technical Education Act. A suggestion has also been made that, in the present impecunious condition of many of the smaller free libraries, owing to the insufficiency of the rate, the various scientific societies might make small grants of books on various industries carried on in the several localities and connected with their object, following somewhat on the lines of the scientific grants of the British Association; also, that assistance might be given in the formation of small museums of a practical kind in each of the manufacturing localities, and by lectures and classes treating upon kindred subjects. Mr. Lancaster's paper was of a thoughtful and practical character, evincing much research and considerable intelligent observation. Another metropolitan critic says of this paper, "A most important subject, treated with much knowledge and sympathy." A description of an east-end London library at Bethnal Green was given by its custodian, Mr. G. F. Hilcken. This is one of the three London libraries established on the voluntary principle, and is a remarkable instance of

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what can be done by combined influential voluntary effort. It has been in existence for thirteen years, and its last year's income amounted to £1,670. It has been the means of incalculable good to the district, nevertheless its existence must always be most precarious. Voluntary effort can never be a satisfactory basis of support. Great credit, however, is due to those gentlemen who, through good and evil report, have stood by it for so long a period with so large an amount of success and encouragement. Mr. Thomas Mason, of the St. Martin's Public Library, Long-acre, London, formerly of the Mitchell and Stirling Libraries, Glasgow, read an able paper on "Fiction in Public Libraries" This led to a lengthy but somewhat unsatisfactory discussion, "as you were" seemed at the close to be the general verdict. Papers were also read by Dr. Garnett, of the British Museum, on "Colophons of the Early Printers;" Mr. Hutton, of the National Liberal Club, on "A New System of Size Notation;" Mr. Jno. Taylor, city librarian of Bristol, on "The Monastic Scriptorium;" Mr. C. Welch, Guildhall Library, on "The Bibliography of the Livery Companies;" Mr. T. G Fleay, on "Modern Shakespeareana." A paper by Mr. W. E. A. Axon, "On the Extent of Modern Shorthand Literature," had been previously printed and circulated among the members, and was taken as read. Mr. Axon stated that there were 837 distinct systems of shorthand, of which 307 were English, dating from 1588. A plan for a handbook on the organization of Free Libraries was ordered to be prepared. It was decided to hold the next meeting at Reading, the present able librarian of the British Museum to be the president, and Mr. W. Lane Joynt, of Dublin, the vice-president. The meeting just concluded, in some respects at least, was a distinct advance on former years. The discussions were fuller and longer, tending in the direction of removing a serious defect much felt and commented on. It was thought, however, by many that several valuable papers, though ably written, were more suitable for the columns of a magazine or for Antiquarian or purely literary societies, than for reading at the meetings of such a body as the Library Association.

Reviews.

Chemical and Physical Studies in the Metamorphism of Rocks. By A. Irving. D.Sc., B.A., F.G.S. [London: Longmans, Green and Co., 1889.]

This work emanates from an author who is known as an earnest and careful thinker and writer on many geological subjects. It consists of a thesis written for the Doctorate in Science in the University of London, together with a number of appendices in the form of notes, dealing with various subsidiary matters, which could not be well worked out in the original thesis. In a "prefaratory note" the author pays a tribute to the departure which the university has now made in recognising original work and individual research. Within the last few years special attention has been given to the study of petrology, especially with reference to those peculiar crystalline masses of rock included under the term "metamorphic," which form some of the most ancient portions of the crust of the earth which geology has as yet been able to discover. In England, research in this direction has mainly proceeded on microscopical lines, and by the indefatigable aid of such workers as Judd, Sorby, Allport, and Bonney rapid strides have been made towards placing the science of petrology on a surer foundation than heretofore. In regard to the chemico-physical aspect of the question, much, however, remains to be done, and it is precisely in this side of the study that our latest geological text-books are deplorably deficient. The treatise now under notice will, if it do no other service, prove useful in inducing a more earnest investigation into the chemical aspects of rock-metamorphism, an outline of which is attempted by Dr. Irving. In the compass of a handy volume of some 130 octavo pages we have presented to us quite a mass of suggestive facts, all of which are necessary in the consideration of a subject of such difficulty as that of the nature of the internal changes to which rocks have been subjected, besides which the leading theories of German and other authors are considered as fully as space permitted. We have no hesitation in saying that the methods of study inculcated by Dr. Irving will be a revelation to many of our teachers of geology. They afford evidence of the change now current in the style of geological teaching of the present day. The term "metamorphism" is limited by the author to changes in the internal structure of rock masses, and everything connected with external conformation, which is purely accidental, is excluded. From the nature of the treatise, principles are dealt with rather than the rock-classifications of the text-books. The subject is divided into the following heads:—(1) *Paramorphism*, in which the original minerals composing a rock-mass have been more or less altered in chemical composition; (2) *Metatropy*, or changes in the physical characters of rock-masses without any essential chemical change; (3) *Metataxis*, or changes in order of the constituents of rock-masses (*e.g.*, slaty cleavage); (4) *Hyperboric change*, such as the introduction of a new mineral into, or the removal of an old mineral from, the original rock-mass, as instanced by the dolomitization of limestone. Into the various controversial and other points opened out by the discussion of these several classes of metamorphism we have not space to enter, even if such criticism were necessary. Many of the author's remarks on the phenomena of cleavage are useful. We do not, however, think that he has altogether grasped the question of the contortions in mountain chains. He considers that pressure is in itself a sufficient *vera causa* of cleavage, and appears to agree with the view that settling down of the central parts of a mountain chain would tend to produce a feeble strain-structure rather than cleavage. We do not notice that the views on the physics of mountain ranges, recently advocated so ably by Mr. T. Mellard Reade, are referred to in this connection. Regarding the vexed question of the Archæan rocks, Dr. Irving accepts the conclusion that these may be regarded as "representing, upon the whole, the primordial (first formed) earth's crust, from which the siliceous materials of the sedimentary rocks have been for the most part derived," a statement which, we fear, will be received with some hesitation by the majority of geologists. We have pleasure in recommending a perusal of this treatise to all who watch with interest the progress of modern geological science.

Magazines and Serials.

The Photographic Quarterly. Edited by C. W. Hastings. [London: Hazell, Watson, & Viney, Creed-lane.]—Almost every month a new journalistic venture devoted to the photographic art makes its appearance, indicating confidence in increasing number of devotees to this fascinating art-science. This new addition to the ranks of the "quarterlies" is, however, a marked advance, both typographically and as to the nature of its contents, upon any photographic periodical with which we are acquainted. The first number, bearing date October, consists of over a hundred octavo pages, printed in clear type on good paper, and embellished with two mounted photographs, one being an excellent portrait of Mr. James Glaisher, the president of the Photographic Society of Great Britain, and the other being an artistic view of Salisbury Cathedral, from the bishop's garden. Mr. C. H. Bothamley, F.I.C., contributes an article upon "Chemistry and Photography;" Mr. J. Hall Edwards, L.R.C.P., is responsible for a well-written illustrated paper on "Photo-micrography;" Mr. W. Jerome Harrison, F.G.S., who, of late years, has come to the front more as a photographer than a geologist, discusses the question, "Was Photography Discovered a Century Ago?" and there are eight other able articles bearing on technical or artistic aspects of photography. We cordially wish success to the new "quarterly."

The Tocsin is the title of a new monthly journal devoted to "general and medical philosophy," edited by F. A. Floyer, M.B. (London: 9, Finsbury-chambers). The artleles contained in the magazine are all readable, and touch upon a variety of social questions, more or less intimately connected with medical philosophy and reform. From a brief paragraph in the number of the journal which lies before us we learn that the views advocated on the subject of vaccination are not of the kind usually considered orthodox.

Appendix to Third Report on the Copepoda of Liverpool Bay. By I. C. Thomson, F.L.S.—In this short paper is described a new and interesting species of copepod dredged in Port Erin Bay this year, since the "Third Report "on the local copepoda was published. The specimens were found in

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washings of muddy sand, dredged from five fathoms. The new discovery has been named *Jonesiella hyænæ*. A well-drawn plate accompanies the letterpress.

Proceedings of the Liverpool Geological Society.—Session 1888-9. Edited by W. Hewitt, B.Sc.—This publication forms the first part of a new volume and is unusually bulky. The papers printed are all of a high standard, and contain much original matter. Mr. H. C. Beasley devotes his able presidential address mainly to a survey of the problems of interest displayed in the geology of the district around Liverpool. The vexed question of the origin of the Triassic rocks is also briefly touched upon. Mr. G. H. Morton, F.G.S., contributes two papers—one on the section exposed in the Manchester Ship Canal cuttings and borings on the Stanlow, Ince, and Frodsham marshes; the other on some faults exposed in shafts and borings in the neighbourhood of Liverpool. The Permian Conglomerates of Morecambe Bay are treated of in a pleasant manner by Mr. J. J. Fitzpatrick; Messrs. Holland and Dickson describe some volcanic rocks of the Isle of Man, and Mr. J. Lomas contributes some "Notes on Basaltic Dykes in Mull." Two papers by the late Sir James Picton are here printed, entitled respectively "Notes on the Local Historical Changes in the Surface of the Land in and about Liverpool," and "The Vyrnwy Valley: its Geological and Glacial History," the latter supplemented by an illustrated note by Mr. G. F. Deacon, M.Inst., C.E., engineer to the Corporation. A lengthy paper on "Slickensides and Normal Faults: their Characteristics and Cause," is also given from the pen of Mr. T. Mellard Reade, who, in his larger work on "Mountain Ranges," and in articles in our own pages, has already done much to elucidate this branch of dynamical geology.

Chester Society of Natural Science.—18th Annual Report, 1888-9.—This successful society, which was founded in 1871 by Charles Kingsley, is now divided into eight sections, including the new section for "Literature." During the past year the debt on the Museum Building has been wiped out, and, as the local collections have outgrown the accommodation, further extensions of the building are contemplated. Five long excursions and eleven evening rambles were held. The Kingsley Memorial Medal was presented to Mr. Shepheard for his microscopical researches amongst the polyzoa and infusoria. The general and sectional meetings have been well attended. A large number of specimens have been added to the Museum.

Annual Report and Proceedings of the Liverpool Science Students' Association.—Session 1888-89. Edited by J. Butler Davies, Hon. Sec.—The report shows this association to continue in a flourishing state, the total number of members being now 99. During the session 17 papers were read at the various meetings, and 10 excursion meetings were held, including some visits to works and manufactories. The following papers appear in the proceedings:—President's Address, by Osmund W. Jeffs; "Artificial Illumination Under Scientific Conditions," by H. A. Hill, M.I.C.E.; "Botanical *Résumé* of Summer Work," by Miss E. M. Wood; "Economic Entomology," by E. D. Fish; "Microbii: a general account of the minutest organisms," by Dr. J. R. Logan; and "The Skull and its Story," by James Hornell.

The Johns Hopkins University Circulars (Baltimore), September, 1889, contains two important mineralogical papers, viz., one entitled "Contributions to the Mineralogy of Maryland," by Mr. George H. Williams, in which the author describes a large number of additions lately made to the knowledge of mineralogical occurences, both within the Baltimore neighbourhood—a district of 625 miles—embraced within the limits of the University Field Club Meetings, and other parts of the State of Maryland; and second a most interesting note by Mr. A. C. Gill, in which very detailed chemical analyse are given. There is also a paper on a very practical investigation, "The Ravages of Oyster Beds by Star Fish," which we reprint on another page, besides other interesting matters, including the index to volume 8, November, 1888, to November, 1889, which clearly indicates the wide scope of the journal. This is but one of several valuable publications issued under the auspices of the university. Indeed, the work done by this institution is valuable in many directions, and the manner in which the students are stimulated to work at original investigations must have an important bearing, not only on American scientific research, but must also stimulate workers in other countries.

The Influence of Forests.

IN our September issue we printed an article on "The Influence of Forests on Climate," which was subsequently copied in the London *Globe* and brought the following communication to that journal:—

"As I take a great interest in this subject, you will, I hope, alow me to comment upon the summary you give of Dr. H. E. Hamberg's researches upon the influence of forests. The effect of forests must be considered not merely in regard to climate, but in regard to the general well-being of animal life. Therefore, when Dr. Hamberg concludes "that the climate of Sweden rests upon a more solid basis than the forests, and that there are more weighty reasons to preserve the forests than the climate, upon which research had shown they had very little influence," it must not be too readily assumed from this that he "disproves the theories held upon the point—*i.e.*, climate—by students of forest culture." Dr. Hamberg has simply taken the temperature underneath trees, and compared it with that of clearings of free land, and from the facts so gained he argues. But this is much too narrow a way of looking at the matter; it would be quite as reasonable to infer the uselessness of vegetation for all purposes save food, from the fact that air is chemically purer at sea than upon land. We must look at the question of aboriculture from a much larger point of view. Meanwhile, it is important to notice that Dr. Hamberg is alive to the necessity of maintaining our forests, and in a destructive age like the present this is most important. The pity is that he should have uttered anything seemingly in opposition to the maintenance of forests, and this, too, on insufficient evidence, of course supposing him correctly reported. The effects of forests are manifold, and it would occupy too much space to discuss the subject at length. But as regards Dr. Hamberg's contention of there being little difference between the temperature of the cleared and the forested ground, we can accept this statement and yet not admit his conclusion as to the consequent absence of effect upon climate. The term climate has a very wide significance, and conclusions regarding it can only be drawn from very wide and general observations; when we can show that the food of animals is derived from vegetation, and that the tree is the king of vegetation; when, moreover, we can point to the fact that no land which is covered with trees can be other than moist and well-watered; when, still more, all history shows that the destruction of trees means the disappearance of animal life, the king of which is man; and when, besides this, we consider that the world has to supply food and comfort for an ever-increasing population, then it is a thousand pities that any scientific man should take pains to disparage the growing conviction among civilised people that the future prosperity of the human race to a very large extent depends upon aboriculture—in other words, upon the scientific distribution of trees throughout the world.—I am, sir, truly yours,

October 12th. R. T. C."

Letter to the Editor.

GOLDEN EYE DUCKS.

SIR,—During the last summer, a pair of golden eye ducks have bred on the margin of Swensty reservoir. On my rounds of inspection, morning and evening, I frequently saw one or both. Every care was taken of them, and they got their young clear away. I afterwards found the old male bird dead upon the embankment. The young ones may be seen anytime. On September 14th, in company with Lord Walsingham, we rushed them twice. The golden eye is a regular winter visitant to those reservoirs in flocks of about twenty.

WM. STORY

Publications Received.

The Creation and Physical Structure of the Earth, by Thornhill Harrison (Longmans); *The Hand-footed Labyrinthodont*, by Jas. Hornell (copy of paper read before the Liverpool Geological Association); *Elements of Physiology*, by Dr. J. H. E. Brock (Chapman & Hall); *Introductory Lessons in Quantitative Analysis*, by John Mills and Barker North, Assoc. N.S.S. (Chapman & Hall); *Solutions to Questions set at Examinations of Science and Art Department—Machine Construction, 1881-86*, by Henry Adams, M.I.C.E. (Chapman & Hall); *The Johns Hopkins University Circular* (Sept.), Baltimore; *Catalogue of the Collection of Meteorites of Jas. R. Gregory; Annual Report of L'pool Geological Association, 1888-89*; *Brewer's Journal* (Oct.); *Optical Magic Lantern Journal and Photographic Enlarger* (Oct.); *Gas and Water Review and Journal of Electric Lighting* (Oct.); *The Photographer's World* (Oct.); *Life Lore* (Oct.); *Naturalist* (Oct.); *Wesley Naturalist* (Oct.); *Knowledge* (Oct.); *Yn Lioar Manninagh*.

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NOTICES.

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the followlng numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Has Pure Water Any Colour?

BY DR. MCPHERSON, F.R.S.E.

(Lecturer on Meteorology in the University of St. Andrews.)

UNTIL very recently it was generally stated without contradiction that pure water had no colour. It is passing strange that scientific men did not see that in asserting a negative as to the colour of water they were infringing an established logical rule. In certain cases to assert a direct negative requires absolute knowledge.

Yet it was an excusable mistake for men to say that water was not coloured. Examining, as we did to day, the spheroidal masses of water on the green blades of swedes after a heavy night's rain, we could excuse one for saying that that water was absolutely colourless, so crystalline was it in its purity, so brilliant in its light-transmission.

A great Scottish scientific authority, Sir Robert Christison, only seventeen years ago, expressed an opinion that water was colourless. Of course he admitted that water which had organic and inorganic particles in suspension showed colour, according to the character of these impurities. But it is not about impure water we are writing; it is about water freed from all the animal, vegetable, or mineral particles held in suspension. Sir Robert made hundreds of careful experiments, but his mind seemed to have been unconsciously biassed not to detect colour. He had no courage to break through the scheduled monopoly of water as to its colourlessness. He tested the brilliant water from the upper part of Loch Goil, in the west of Scotland. He filled a sixteen-inch glass tube (closed at one end) with the sparkling water, and held it vertically over some white paper in a bright light. His eye could discern no colour, though looking down the whole tube. Next, he looked obliquely through the tube, standing two feet away from it; yet the water appeared colourless.

Sir Robert detected a slight yellowness in the waters of Loch Katrine, Sir Walter Scott's crystal lake, but this he attributed to the matter held in suspension. In distilled water and pure spring water he thought there was no colour. Other scientific men, however, could not be satisfied with this conclusion; it was so illogical and apparently untrue. Several years before, Sir John Herschell stated his difficulties about the no-colour theory, and remarked in a semi-prophetic way that water has an absorptive colour proper to it, if a thorough investigation were made. Tyndall then showed by experiment that even distilled water had a decided colour. He passed the light from an electric lamp through eight feet of water in a tube, and threw the image of the lower end of the tube on a screen by means of a magnifying apparatus. He stated that the colour of the water was blue-green, and to him is due the discovery of the property of colour in water, though he did not hit upon the exact character of the colour.

Thirty-five years ago Admiral Smyth, who once held the opinion that the deep blue colour of the water of the Mediterranean Sea was attributable to the reflection of the blue sky overhead, was struck with the fact that the sea had often a deeper hue than that of the sky.

These suggestions set agoing the fertile brains of Mr. John Aitken, of Falkirk, who, in his search for health, had many opportunities of testing the properties of natural phenomena. His perseverance in the investigation of the colour of water is most praiseworthy, and has been rewarded by his undeniable discovery that *distilled water has a blue* colour,

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It is a well-known fact that colour, transmitted through bodies, differs considerably from colour reflected by them; but it must be remembered that, though the mixture of the *pigments* of blue and yellow produces green, the *lights* of these two colours produce white. Mr. Aitken found that water is a blue transparent medium, absorbing the rays of the red end of the spectrum and transmitting the rays of the blue end. He let down into water a metal tube (which was open at the top and closed with a clear glass plate at the bottom) close to a white object, twenty feet below the surface. This object when looked at through the tube was of a most beautiful blue colour. Now, the object would have appeared to be yellow (the complementary colour) if the colour of the object was due to the light reflected by extremely small particles of matter suspended in the water. He next blackened the tube and filled it with the water, placing the glass bottom close to a white object. He found that the light transmitted was blue, the water absorbing the rays of the red end of the spectrum. When white, red, yellow, and purple objects were thrown into the water their colours changed in the same way as if they were looked at through a piece of pale blue glass: the white object appearing blue, the red one darkening as it sank and soon losing its colour, the yellow one changing to green, and the purple to dark blue. He concluded, then, that water is a blue transparent medium which acts like a solution of prussian blue or like a blue-coloured glass.

Nor did Mr. Aitken rest satisfied with his experiments on ordinary lake or river water. He examined distilled water. By three different sets of apparatus he distilled and tested three different samples; one complete set of apparatus was made of glass, one of brass, and one with a platinum condenser. These samples of distilled water he successively put into the long blackened tube and examined as before; the effect in all was the same—the colour was blue. This forced him to the remarkable conclusion that the purer the water the bluer is its colour.

Then, have the solid particles which are held in suspension no effect upon the colour? Yes, these determine its *brilliancy*. A piece of blue glass or a blue solution has little colour when looked at from the side on which the light falls. Something more, then, is required to account for the brilliancy of such waters as the Mediterranean or the lakes in the Cordilleras. These brilliantly-blue waters hold in suspension millions of dust-particles of different kinds, which produce the varied colouring. In the Mediterranean this fine dust is whitish. In some places there are far more particles in suspension than in others. Where there are few particles the colour is deep blue, since there is a smaller quantity of reflected light and the light penetrates to a greater depth. But where there are many particles, the colour is chalky blue-green, owing to the increase of reflected light. At Mentone, the limestone easily ground down makes the water brilliantly blue; but at Cannes, where there is no limestone, the water is duller. Absorption, then, determines the blueness, and reflection the brilliancy.

An additional experiment may be quoted which confirms this conclusion. Take a dark metal vessel and fill it with a weak solution of prussian blue. The solution appears quite dark and colourless. But throw in some fine white powder and the water will become brilliantly blue. Add a little more of the powder and the brilliancy will increase. This accounts for the changes of depth and brilliancy of colour along the shores of the Mediterranean. The beach along the coast of Cornwall is at many points covered with a whitish sand, which accounts for the particularly bright blue colour of the water. The waters of the lakes in the Cordilleras are reported to be of a most extraordinary brilliant blue colour, owing to the fine white sand held in suspension. Along the Scotch coast, where the sand is yellow, the water takes a greenish tint, as all divers know when they open their eyes below the water.

The waters of several lakes were next examined by Mr. Aitken. He found the water of Lake Como, in Italy, of a deep blue colour, but void of brilliancy, because of the absence of white reflecting particles. But, where the current from the lake rubs down fine reflecting particles from the rocks as it enters the Adda, the water becomes beautifully brilliant. As the Rhone grinds down the rock particles and conveys them into the Lake of Geneva, the reflection of light from these particles intensifies the brilliancy of the natural blue of the water, and produces a colour which rivals the beauty of any water in the world.

Of course some waters appear to have other colours on account of the myriads of coloured animalcule and vegetable forms suspended in or floating on them. Vegetable matter accounts for the particular colour of the Red Sea. Along the coast of China, the Yellow Sea derives its name from the peculiarly coloured matter in suspension. Miles in breadth of densely-crowded, minute, phosphorescent animal organisms present at night the appearance of a boundless snow-clad plain. Yet these colours and phenomena have nothing to do with the inherent colour of water itself. When the organisms are removed, and the water is distilled, it is found to be of a blue colour.

Imagination may picture the reflection of the blue sky in the mountain tarn as the magic influence by which its brilliant hue entrances the traveller's eye. As a mirror the smooth surface may picture the shifting glory, but not the permanent brilliancy and beauty. The heavens above and the suspended particles in the water help to bring out the grand effect which charms the poet and the painter; but the water itself is blue. Blueness is its normal colour.

Scientific Aspects of Health Resorts.

VIII.—Bournemouth.

OF all beautiful and health-giving spots in Great Britain, Bournemouth is *par excellence* the place to which may be conceded the title of the "Empress of watering places." Warm and sheltered in the winter, cool and shady in the summer, and possessing advantages and attractions beyond those of any other resort on the south coast, we may be well assured that, with its delightful climate, its charming situation, and its extremely picturesque surroundings, it need fear no rival.

Bournemouth is really unlike any other watering place in our island. Viewing the bay from the pier-head we have before us a panorama of surpassing beauty. From Christchurch Head on the right to Poole Harbour on the left—a distance of about ten miles—we see stretching away on either side high cliffs of golden sand crowned with the verdure of ever-green pine trees, and intersected here and there by the numerous chines which have been formed—and are still forming—through the action of running water upon the incoherent sand. Looking seawards from an eminence, such as the higher land of the West Cliff, we have before us—if the day be clear—a lovely marine picture. In the distance to the left we see the Isle of Wight, with the Needles and Alum Bay clearly depicted; while on the right the Old Harry Rocks, and the pretty bay of Studland, with its long stretch of white sand forming a pleasing contrast to the blue sea and the dark moorland beyond.

The town of Bournemouth is of recent origin. It is situated in the valley of the Bourne, an extensive chine that has been scooped out of the sandy strata by the combined action of the stream and aerial denudation. On either side of the Bourne for a considerable distance the land has been laid out into "The Pleasure Gardens"—a grand illustration of the way in which man can improve waste heath-moor, and where, owing to the sheltered situation and the zealous care bestowed upon the vegetation, there is a luxurious growth of tender flora. On either side of this valley, extending to Boscombe on the east and Branksome on the west, are dotted here and there amongst the pines detached

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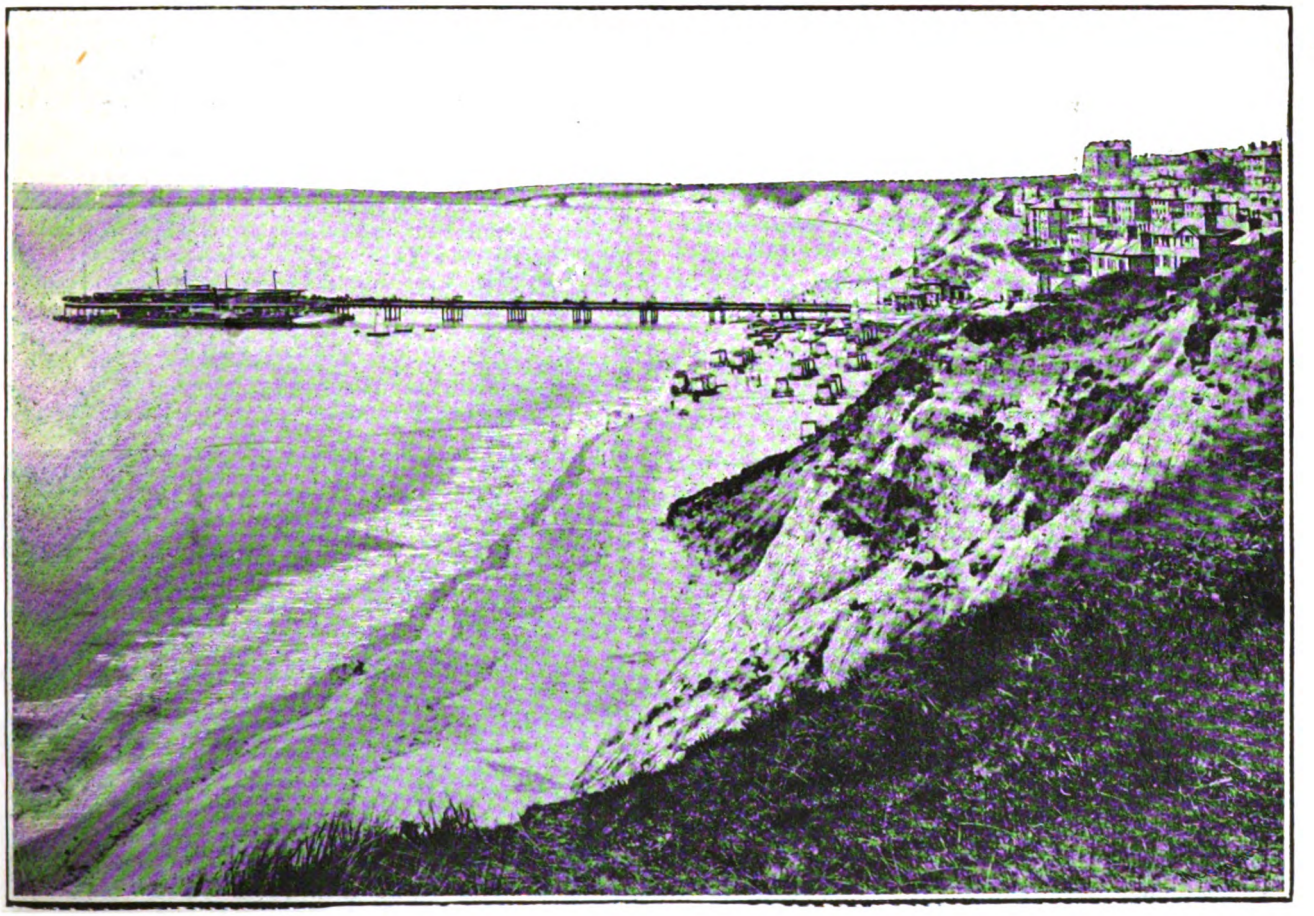
residences, which, unlike the long, formal terraces of most seaside resorts, give the landscape so picturesque an aspect.

The climate of Bournemouth is really one of the chief advantages of the place; so much has been written upon it that it would be unnecessary to give a long dissertation here; we have, however, all the conditions requisite to produce one of the most equable and delicious climates of which England can boast. The shelter of the pine forests, the porous nature of the sandy soil, the southern aspect, and the proximity of the sea all combine to provide the requirements essential for the production of a dry and equable climate. On the West Cliff and at Westbourne, where the pines are less numerous, and where extensive areas of high heath-land occur, the air is undoubtedly more tonic and bracing than that of the lower parts of the town or that of the East Cliff.



Bournemouth Bay, looking West from the East Cliff towards Poole Harbour.

From a Photograph by Carl Norman.

The geology of the district is extremely interesting, and could not possibly be fully described in a short article such as this. All the sands and clays of the neighbourhood are of Tertiary Age, and belong to the Eocene Formations, consisting of the Bagshot Beds, which cover so extensive an area in the south-west of Hants.

In Bournemouth Bay we have a development of the middle Bagshot Beds—equivalent to the *calcaire grossier* of the Paris Basin—and these *Bournemouth Beds* have been sub-divided into two series, the Lower or Freshwater, which may be seen in sections along the cliffs from a short distance west of the Red House to Steps Chine, and the Upper or Marine series, from Steps Chine to a point about a mile beyond Christchurch Head. These beds are, however, often difficult to determine on account of the debris and talus resulting from the rapid denudation which is taking place all along this unstable coast.

These *Bournemouth Beds*—which show evidence of having been deposited by a river flowing from the S.W.—have been well described by La Harpe, Gaudin, and, more recently, Starkie Gardner; the latter has pointed out three separate groups forming the freshwater beds, and considers each may be separated from the others by the characteristic fossil-leaves found in each bed. These leaves and plant remains are well preserved in the clays deposited in parts of the sandy strata, but not only in the clays, for we have found well-preserved impressions on some of the fine layers of sandstone that are occasionally present. The palms, ferns, and leaves found in these beds prove that the climate of those times was of a sub-tropical character. The accompanying wood-cut (p. 124) shows the outlines of some of these leaves.

The upper, or marine, series are composed also of sands and clays of varied tints, and these contain shells of marine genera, together with such fossil flora as Nipadites (like the Nipa of Bengal), Palmacites, and coniferous remains akin to those found in the Bovey Beds.

The Bournemouth Beds are capped almost everywhere with gravel deposits of more recent origin, composed of rounded and sub-angular flints. These gravels have yielded flint-implements, and we have also found derived fossils in the form of the siliceous casts of Echini from the chalk; they also contain pebbles of vein-quartz and granite which have probably been transported from Cornwall by fluviatile action. Over these gravels, in some places along the coast, are accumulations of blown-sand; these contain decomposed vegetable remains, together

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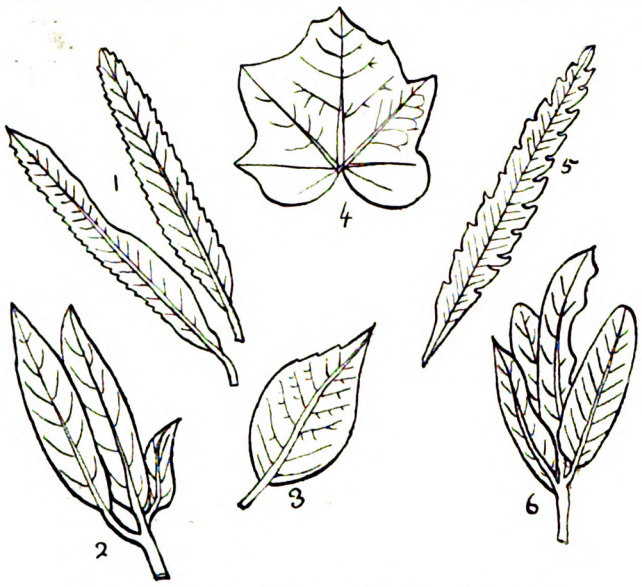


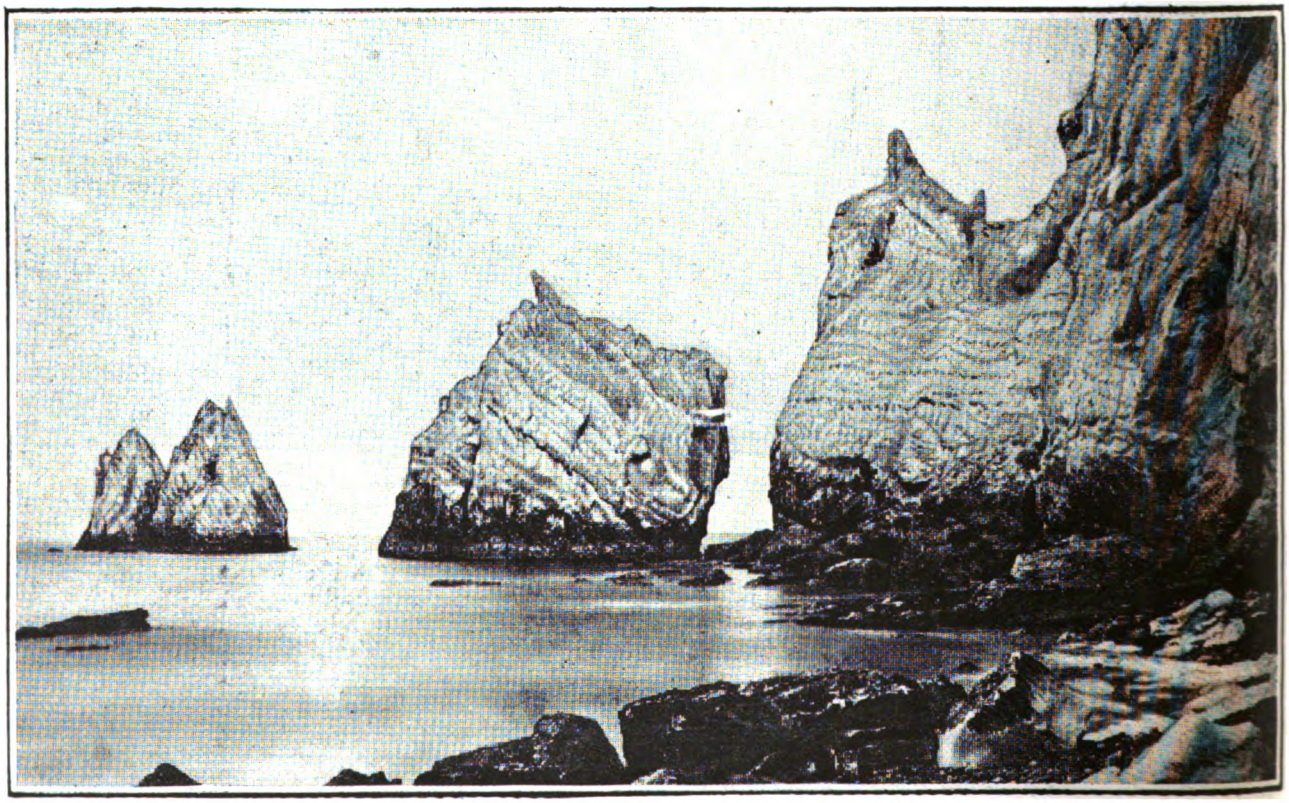
TERTIARY LEAVES FROM THE BOURNEMOUTH BEDS.
1, Laurel; 2, 3, Beech; 4, Maple; 5, Dryandra; 6, Oak.

with, though rarely, land shells; in places where the top layer of gravel is bleached to some depth we may probably assign the cause to the action of the humic acids.

Generally speaking the sands of Bournemouth are of a light yellow colour, but they vary from pure white through all the many shades of yellow to deep black. The thickness of the limonitic layer surrounding each grain may determine the depth of colour, while the black sand is due to a combination of limonite and carbonaceous matter.

In connection with this an interesting experiment may be tried:—A small quantity of the deep yellow sand on being heated in a test-tube turns red—an effect we first observed was produced by the heat of a picnic fire on the beach. The hygroscopic water is driven off from the limonite, and we thus have its conversion into hematite—the anhydrous form. The sand grains are composed chiefly of quartz, and these are, as a rule, more or less angular; but where blown about by the wind they become rounded, and we have also frequently found perfect microscopic crystals. There are grains also of vein-quartz, tourmaline, flint, &c., together with microscopic gems, such as zircon, rutile, &c. These denser minerals often form dark patches upon the surfaces of the sand-dunes by the separating action of the wind. We have collected them by means of damp blotting-paper, and also by a process already referred to in this journal (*Research*, vol. ii., No. 14, p. 32). The sands—save in a very few instances—are extremely incoherent, being bound together simply through the superincumbent pressure, and not by any cementing material.

Much more could be written about the geology of the immediate neighbourhood, but we would prefer to close our remarks by alluding to a few of the most interesting geological studies in the district. By taking one of the many steamers that run to Swanage we may study the fine natural section of the Purbecks, with the "Dirt" and "Cinder" Beds at Durlstone Bay, and, after a hunt for reptilian remains in the "Crocodile" Bed at Peveril Point, we may retrace our steps, pass through the town of Swanage, and then walk along the shore of Swanage Bay in the direction of Ballard Point. Along this bay we pass in succession the Hastings Sand, the Punfield Beds of Judd, the Lower and Upper Greensand, with about 40 feet of Gault between,



THE NEEDLES, ISLE OF WIGHT.

From a Photograph by Poulton & Sons.

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and finally reach the Chalk. The Chalk here shows a fine vertical section, due to a fault, and this may be well studied from the deck of the steamboat on the homeward journey. The "Old Harry" Rocks, off the Point, afford a good illustration of the "stacks" that result from marine denudation, and it is interesting to note that it is due to this long-continued action that the Chalk no longer stretches across the channel to the Needles, off the Isle of Wight, as once it did. Looking towards the land when off the "Old Harry," we may see the pretty village of Studland nestling in the bay; and beyond this, if the day be clear, we may descry the celebrated Agglestone Rock—a huge mass of ferruginous grit and sandstone, which stands alone as a monument to the

OLD HARRY ROCKS.

From a Photograph by Frith

strata which have succumbed to the hand of Time. Its computed weight is 400 tons, and it appears to have been placed on a conical mound. A visit to this rock shows it to be simply an isolated mass of Eocene age, which, by its superior hardness, has been enabled to resist denudation more effectually than the surrounding strata, and the conical mound upon which it appears to rest is simply the surrounding talus which has resulted from its own destruction.

From Studland to Poole Harbour we may see a long stretch of white sand, and it is here that the remarkable and interesting phenomenon of "musical" sand occurs, the details and particulars of which have already been published (see *Research*, Vol. i., No. 8 "Reviews"). The sands of Studland abound in shells, and many rare species occur; foraminifera occur also in great abundance.

Space will not now permit us to do more than briefly mention the well-known Barton Beds beyond Christchurch, with their marvellously-preserved fossils and "pockets" of "Highcliff sand"—a sand composed of fine angular grains of quartz, crowded with minute microscopic shells; and the celebrated vertical section of the Barton and Bracklesham Beds, with the tulip coloured sands, at Alum Bay. These, together with White-cliff Bay, "the most perfect section through the Eocene formation in England," and many other places of great geological interest, are easily accessible from Bournemouth. C. CARUS-WILSON, F.G.S.

Archæological Notes from Scandinavia.

Of late several interesting archæological discoveries have been made in Scandinavia. In Norway a burial chamber of the early iron age has been discovered at Gloppen, on the west coast. It was twelve feet in length and made of stone slabs. It contained the remains of a large man, who had evidently, judging from hair and claws beside him, been laid on a bear skin. There were also traces of woollen clothes, and the lining of the neck, woven with ornaments of animals, was well preserved. The chamber also contained a bucket made of lime wood (*Taxus pacata*), a kind of wood always used for this purpose in the early iron age; two iron lance heads, 12 inches long; a double-edged sword in scabbard, with ferrule of bronze, and a wooden sword haft; a bronze buckle, a Roman gold coin, a pair of bronze scales, some arrow heads, and two clay urns, richly ornamented. However, the most interesting find was the remains of a glass beaker, green and blue in colour, with fluted ornamentations. The man had, evidently, also worn a leather belt with two red stones of quartzite set in bronze, in which had hung a pair of scissors in a wooden sheaf, the latter being carved—a rare discovery. Between the two belt stones lay a curious object, consisting of three pieces of wood linked together, which Norwegian archæologists can only compare to the modern "mind" puzzle. This must have laid between the man's hands. The latter, the beaker, and particularly the ornamented dress lining, are unique finds. All the objects are now in the Bergen Museum.

On examining a viking tumulus lately at Hosmestad, in Stange, a vault seven feet long was come upon. The walls and roof were made of limestone slabs, with a layer of gravel above. In the chamber were found a bronze chain and remnants of a bronze buckle, which had belonged to it, some pieces of an earthenware jar, a skull, and a lot of human bones. The grave dates from the fourth century. The objects go to the Christiania Museum.

In Stokke, by the Christiania fjord, another viking barrow has been excavated, containing a similar chamber, 13 feet long. It lies N.S. However, as yet, the chamber itself has not been explored.

An interesting work has just appeared in Norway upon the swords of the later iron age by Dr. A. Lorange, of the Bergen Museum, who, having carefully cleaned these swords in that institution, has found upon them Latin letters and certain marks. One of the commonest names upon them is that of ULFBERHT, and Dr. Lorange comes to the conclusion that these swords were not, as hitherto supposed by Norwegian archæologists, made in Norway, but that they were imported from the land of the Franks, on the north-west coast of France. He is further of opinion that several other objects said to be Norse are of Frankish origin.

In Sweden, too, interesting discoveries have been made, viz., at the Igelsta Bay, near Södertelje, where a place has been discovered, which is declared by the celebrated antiquarian, Professor Hildebrand, to have been a kind of manufactory of stone implements during the stone age. This is the more remarkable as the spot is the northernmost in Sweden where flint implements have been found.

A little south of the Göta Canal, in the province of Skaraborg, a Runic stone, ten feet high, has lain for years, which has been raised.

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he front bears a cross engraved, somewhat like a Maltese cross, below which is the following Runic inscription :—

DAUR, HATJKR, HARUARDR, RAJSTU, STAIN, IFTJR, KUNAR, FADUR, SIN.

The translation being : They, Hating and Harvard, raised (this) stone after (in memory of) Gunas their father (lit. father theirs). On the back are cut the figures of three animals, two being a lion and a dog, and the third indistinguishable.

Professor Hildebrand recently gave an interesting lecture upon the implements of the stone age, of which the following is a *résumé* :—The best implements were of flint, but many were made from other kinds of stone. Horn and bone were also used, and even wood, but the latter had, of course, decayed. Flint implements in Sweden were only met with in the province of Scania, in the extreme south, as flint implements found in other parts—as, for instance, those found by the Byske River in the north, or the huge flint axes found in Central Sweden—had been imported thither. The case was the same in other parts of Europe ; flint implements were plentiful in some places and scarce in others. Thus, they are numerous in the neighbourhood of the river Vistula, and poor in the Baltic provinces of Russia. Flint was of no use for haft-axes, stone having to be used for the same. Having referred to the making of flint implements, the lecturer described the so-called "preparation" stones, used, no doubt, in shaping flint implements, as well as the whetting stones from the stone age. Finally, Professor Hildebrand described the chisels from the stone age, there being two kinds, viz., the rectangular and the hollow ones. Chisels of flint were far more finished than those of other stone material.

One of the most interesting and important archæological discoveries ever made in Scandinavia is the discovery of flint implements, remains of animals, and part of a human skull found in a cave in the Great Carl's Island, off the Island of Gothland, right out in the Baltic, this being the first discovery of remnants of cave dwellers in Scandinavia. The island is uninhabited. However, the authorities of the Swedish National Museum have despatched Professor Hildebrand and others to explore this cave and others thoroughly, and valuable discoveries to the antiquarian are looked forward to. There are also many cairns from the iron age in the island. In order that the caves shall not be disturbed all admittance to the island is, with praiseworthy promptitude, prohibited at present.

In Denmark, too, some interesting finds have been made of late, one being in the town of Ribe, in South Jutland, where another of the great "kitchen middens," for which that country is celebrated, has been dug up. An enormous quantity of all kinds of bones of animals were found, many bearing traces of knives, whilst it was also found that the dwellings of the primeval inhabitants had stood on piles.

Finally : two graves of the form called "ship" shaped ones, dating from the early iron age, have been discovered near Aalborg, in Jutland, similar graves having only been once before encountered in Denmark. They are built of stones in the form of a ship, the calcined ashes of the body being strewn at the bottom. Further : nine graves with skeletons from the later iron age have been found near Frederikshavn, the size of the bones indicating that they were persons of small stature. In addition, four smooth rings of bronze, having, no doubt, formed a necklet, have been dug out of a peat bog in the same locality.

A Runic stone of great interest has been discovered at Kinnekulla, in West Gothia, Sweden, having hitherto been covered with turf. The portion uncovered represents some ships, the figures of two men, a great number of saucer-shaped cavities, wheels, rings, &c., engraven on the rock, but there appears to be a great deal more signs below. The Crown has taken possession of it, and a careful survey is being made.

The Recent Additions Case at the British Museum.

II.

SINCE our brief review of the contents of this case* there have been sundry changes in its occupants, though the *pièce de resistance* still consists of the remarkable group of Calcites from Egremont. Some further illustrations of Calcite from this locality have been added. One of these consists of sharply-pointed scalenohedrons of pure white, sprinkled, as it were, with irridescent iron pyrites, and thus presenting a pleasing combination of colour. Another illustrates clearly, by a series of steps, the relations of the butterfly twin with the simple scalenohedron. From the same locality is another Calcite, with the blue barytes thereon, as described by Miers, in the *Mineralogical Magazine*, No. 38. From the Stauk mine near the same locality is shown a magnificent scalenohedron of Calcite, about 9 inches long, terminated at both ends, and also some crystals of the same form twinned on 110. From Patterdale we have Calcite crystallized as hexagonal prisms, with rhombohedral terminals (Wheal Wrey type). From Lake Superior a crystal of Calcite, perfectly transparent and highly modified, is shown, enclosing native copper, and our notice of this group must close with the mention of an extraordinarily shaped crystal from an unknown locality, which has a hole through its entire length, and which seems to partake of the characters of both crystal and stalactite. Barytes is represented by the finely-coloured blue variety aboue-named and also by some flat, tabular greenish-blue crystals from the same locality, whilst from St. Bees is exhibited a fine rhombic crystal, about 6 inches long by only ⅜ inch wide, thus giving examples of two extreme types in rhombic crystallization.

A fine specimen of pink Apatite with rutile and quartz from Granbundlen should be noted, and the following also caught my attention during a rapid glance :—

SULPHUR from Sicily : crystals of a most beautiful honey-yellow colour.

THORITE : this rare mineral is illustrated by a unique crystal, 2 inches by ⅞ inch square ; a fine prism, with pyramidal terminations.

ALBITE : flat tabular crystals ; from Virginia.

ADULARIA : small, unmodified crystals ; from Wallis.

HANKSITE : finely illustrated by flat, tabular, hexagonal prisms of 1 inch diameter and ¼ inch thick, and also by the still rarer form of the double hexagonal pyramid. The getting of these specimens from the borax regions of California was a work of difficulty and danger.

TOPAZ : in rhyolite matrix, from Mexico, the crystals with sharp pyramidal terminations.

PHENACITE : brilliant crystals ; from the recent finds in Colorado.

BERYLLONITE : a new gem ; from Maine.

QUARTZ : from Brazil, with distinct rhombohedral cleavage.

RUTILE : some brilliant crystals from the now classical locality in North Carolina : and also good ones from Norway.

SPHENE : crystals of 2 inches and upwards of brownish colour ; from Zermatt.

RHODONITE : brilliant rose coloured crystals from Pajsberg, and large pink crystals from Franklin, N. A.

BEMENTITE : a specimen of this doubtful mineral, which is called after the great American collector, is exhibited.

COPPER PYRITES : some sharply defined, though small, crystals on fluor spar, from the now almost worked out Caru Brea copper district in Cornwall.

ANDREWSITE : a good illustration of this rare mineral.

PUCHERITE : a small specimen of this rare vanadiate is well covered with remarkably fine crystals. From Scheeburg.

PYRARGYRITE : the already rich collection of this mineral is increased by a good specimen from Andreasburg, and one from Mexico.

See *Research*, vol. i., p. 171.

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STEPHANITE: several groups of well defined crystals.

VANADINITE: the prolific mines of the Rocky Mountains have given us our best illustrations of this mineral, and the brilliant red crystals now shown are amongst the best ever found.

PERCYLITE: for many years the British Museum possessed the only known specimen of this mineral, but its locality was unknown. Mr. Gregory, however, afterwards discovered it, or an allied mineral, from Namaqualand. Now crystals, sharply defined and of brilliant colour, have been found in the Sierra Gorda, Chili. The specimens shown, where Percylite is associated with other lead minerals, to which the names of *Daviesite* and *Caracolite* have been given, are well described by the curator, Mr. L. Fletcher, in *Mineralogical Magazine*, No. 39.

SPERRYLITE: this curious combination of platinum with arsenic is shown by a small bottle containing minute crystals of cubic habit.

A number of other new minerals are displayed for the first time, but space forbids further mention. WM. SEMMONS.

The Potency of Oil in Storms at Sea.

By RICHARD HOLLAND.

ONE of the most interesting subjects which will be discussed at the International Maritime Conference, now sitting at Washington, U.S.A., is that of the efficacy of oil in calming the broken water that obtains during a storm at sea. So generally recognised is this peculiar property of oleaginous matter as a water soother that calming influence of any kind, whether moral or physical, is frequently compared in its action to oil upon the troubled waters. As early as 354 B.C. we find that the versatile genius of Aristotle had experimented upon this subject, and that he promulgated the opinion that the thin film of oil upon the surface of the waves prevented the wind from agitating the water beneath, and that by this means the wind could obtain no hold upon the water, and was thus checked in its efforts to raise those curling waves so dangerous to the mariner. Some 420 years later we find Pliny the Elder (Plinius Secundus) advocates in his *Historia Naturalis* the use of oil to still the waves raised by sudden storms. The systematic assiduity with which he pursued his scientific researches, and the practical experience gained from his official position as commander of the Roman fleet, unquestionably entitled him to pronounce, with his usual dogmatic conviction, "that the vessels of his fleet should be equipped with store of oil with which to sprinkle the sea in stormy weather," for he goes on to add, "I have often observed that mariners do still the waves by pouring oil into the sea." To this knowledge of the properties of oil as a water soother must be attributed, too, the reckless daring with which the Teutonic Vikings were accustomed to navigate their war-keels during the most tempestuous weather. Their practice of using oil as a wave allayer enabled them, when least expected, to make those successful raids which rendered them such objects of terror to the more peaceful inhabitants of the North Sea littoral. Subsequent to this the practical application of oil to calm a troubled sea would seem to have been relegated into oblivion until a comparatively recent date, for in the records of no great maritime nation do we find any account of oil being used to facilitate navigation.

The Venetians, the Spaniards, the Portuguese, and the early English circumnavigators seem alike ignorant of the proverbial soothing qualities of oil. It remained, however, for Benjamin Franklin to again direct public attention to, and to experiment upon, this subject. He observed in the year 1757 that two ships, which were sailing in company with his own, appeared to be surrounded with a zone of water much more tranquil than that contiguous to his own vessel. On enquiry he found that this effect was owing to the captains of the former vessels discharging through their scuppers some greasy water. He learned, too, that the inhabitants of the Bermudas, the "still vext Bermoothes" of Shakespeare's "Tempest," were fully cognisant of this property of greasy matter, and that they were in the habit, when the agitated surface of the sea prevented their seeing the fish which they wished to strike, of pouring oil upon the water so as to ensure a surface absolutely free from ripples. From these observations and statements of hearsay knowledge the *savant* was himself led to test the power of oil upon a disturbed surface of water. He selected a pond in the neighbourhood of London, and, pouring a teaspoonful of oil upon the windward side of it, he observed an instant calm produced over a surface of several square yards. This region of calm rapidly spread until the whole of that side of the pond, containing about 2,000 yards of surface, was as calm and still as the surface of a looking-glass. From experimenting on a pond he next tried the sea itself. He poured oil into the sea at a distance of half a mile from the shore at Portsmouth. It would appear, however, that this test was but partially satisfactory; for, although a smooth lane of water was perceptible right to the vicinity of the beach, yet there was no material difference in the height or force of the surf that broke upon the shore. Franklin attempted to explain this comparative failure by supposing that the mechanical motion of the waves already raised must go on until exhausted, just in the same manner as an oscillating suspended weight will go on swinging after the original impulse is withdrawn, until such time as gravitation and friction render it quiescent. He held, however, that the action of the oil was to considerably diminish the action of the wind upon the waves already raised, and to prevent at the same time the wind from raising new waves. Beyond this enunciation of Franklin's hypothesis as to oil action upon waves, modern science has advanced but little, but a multiplicity of well-authenticated examples are on record which prove indisputably that, as a power which tends to minimise the dangers and risks attendant upon navigation and transhipment during stress of weather, oil is invaluable. Nor can this knowledge be too widely disseminated among all branches of our marine, both naval and mercantile.

It would seem that Germany and the United States more fully recognise the great importance of this subject, for in a recent issue of the North Atlantic Pilot Chart, the United States Hydrographer, after carefully weighing the evidence adduced before the Hamburg Nautical School, issues brief but useful directions as to the most efficacious manner of distributing oil at sea under conditions of storm. A careful study of the records of the use of oil by shipmasters would seem to establish the following facts:—

1. That the oil used should be either a vegetable or animal oil. One whose specific gravity is about six-sevenths that of sea-water would seem to be most efficacious. Mineral, or light, refined oil of any description, acts very indifferently.

2. That the oil should be allowed to drip into the sea as from a punctured canvas bag. Many masters follow the still easier method of availing themselves of the w.c. openings as exits.

3. That the most effective way of applying the oil is to facilitate its spreading to windward.

4. That the best results are obtained in deep water, and with a moderate consumption of the oleaginous fluid.

A concensus of opinion obtains, that no matter what the size of the vessel, the use of two quarts of oil per hour is quite adequate to produce the highest possible beneficial results. The extreme attenuation of the film or thin sheet of oil that marks the wake of a vessel using it is astonishing. Suppose a vessel running ten knots an hour uses in that time two quarts of oil. She will have oiled a wake ten miles in length, and (say) 40 feet in breadth. Assuming half a gallon to contain 140 cubic inches, and dividing this by the area oiled, say 342,144,000 square inches, we get the astounding result that the thickness of the oil film does not exceed ·000,000,49 of an inch. With reference to the use of

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oil near shore for the purposes of facilitating ingress to harbour, or transference from stranded wreck to shore during heavy weather, many experiments have been made. Among those may be mentioned the firing of shells and rockets, which, when they burst, scatter a quantity of oil over the surface of the waves. By these means a surface of some 2000 or 3000 feet have been rendered calm by a single discharge. Leaden pipes have been laid along the bottoms of several of our exposed harbours with the view of forcing oil through them in rough weather. The oil, by virtue of its low specific gravity, will rise to the surface of the water, and render less dangerous the waves around. The opinion of experts is all but unanimous, however, that in heavy surf, or waves breaking heavily over a reef, oil is of little or no effect. This is a matter of deep regret, for it is under such circumstances as these that our lifeboat crews have to work in effecting their rescues. The executive of the Royal National Lifeboat Institution have, however, joined with the National Sea Fisheries Protection Association, with a view of carrying out a series of exhaustive experiments with oil during the transmission of fish from the smacks to the carriers. It will be interesting to note when the next annual report of the Lifeboat Institution is issued how far these experiments have conduced to solve this most important question. Meanwhile, we feel confident that many valuable lives might be saved around our shores if the small boats engaged in the fishing industry were provided with some apparatus capable of sprinkling oil on the rough sea round the boats during the transference of fish, and so rendering less dangerous a calling which in rough weather is attended with fearful risks. Further, we believe that the evidence so far adduced as to the use of oil in deep water is so strong as to justify the Legislature, at no very future date, making it imperative for every shipowner equipping his ship and boats with suitable oil as a necessary part of their life-saving appliances. No doubt if such were the case rescues at sea would be much facilitated and effected at less risk, while in the case of crew and passengers taking to the boats in the instance of a vessel foundering, the probabilities of rescue would be very materially enhanced. Should any shipmasters put this oiling process to the test, the results might with advantage be forwarded to our leading mercantile newspapers, for the sooner the records of such tests are placed on evidence the better for the future guidance of "those who go down to the sea in ships."

The Pathology of Plant Life.

By C. J. S. Thompson

THE cause of death in a plant, and to what influence the extinction of its life is due, is a subject that does not seem to have been thoroughly investigated, and yet it is one that might be of considerable value to those interested in the varied forms of vegetable life. We know that plants die from disease or decay and other external and internal influences, but no very satisfactory solution seems yet to have been arrived at as to what are the primary causes whose ultimate effect is to arrest the life of the plant. Its health and life mainly depend upon the light, heat, moisture, and nourishment afforded, consequently the withdrawal of any of these necessaries to its existence for a prolonged period prevents the development of new tissue, which nature regularly carries out, and endangers and disarranges the whole organism.

Trees will not flourish in an impure atmosphere, and their growth is impeded in our large and smoky cities. Many die during the winter months, most probably owing to the circulation and the after ascent of the sap being checked by cold and other causes. In winter no transpiration takes place, the wood of the stem and root being filled with watery matter holding starch and other insoluble substances in suspension, and no change goes on. When the spring comes the increased heat and light cause the insoluble starch to split up into soluble dextrin and sugar, development and transpiration speedily follow, with the consequent ascent of the sap and the putting forth of leaves in due time. If these functions are checked by extreme cold or other climatic influences the plant must suffer blight or death.

Plants frequently die from the effects of cold, especially those indigenous to warm and tropical climates and where the light is more intense. Even when placed in our hot-houses, where they may be subjected to the same temperature, often through the heat having to be obtained by artificial means, the secretions are imperfectly formed or not formed at all, and death ensues.

It is a singular fact, and one that proves the extreme susceptibility of plant life to the influence of soil and climate, as stated by Bentley, that certain poisonous plants grown in some districts are quite innocuous and harmless when grown in others. Such a difference can only be attributed to the varied conditions of soil and locality under which the plant is developed to have so important a result on its secretions.

There is no doubt that exogenous trees live to a great age, so it is very problematical if they ever die from old age. Most trees begin to diminish in vigour after reaching 60 years of age, although they vary according to species—the larch about 40 years, the elm after 50 years, the beech 30 years, and the yew and the oak about 60 years. Lindley, in his table of the age of trees, which is perhaps the most reliable, mentions lime trees 1230 years old, oaks that have passed 1000 years, and cedars over 800 years that are still living, and these figures can be proved to be historically correct. Some yews that are also living are stated to be over 2000 years old, so that the age of trees seems to be practically unlimited, climatic and other influences being in harmony. We know that plants which have been kept in a warm place under cover will wither and die if exposed to the ordinary temperature out of doors, or even if placed in a position where they would come in contact with a draught of cold air.

It would appear, then, that there must be some primary cause for cessation of life in a plant, and that primary cause may be due to—First, the arresting or failure of any one of the following necessary functions of its life, viz., absorption, circulation, respiration, assimilation, development, and secretion. Second, by the direct effect of climatic variations and excesses, as cold, heat, moisture, and light. These influences most probably act by diminishing the power of circulation and assimilation, from the deficiency of which the membrane constituting the cell walls gradually becomes hardened and encrusted by the deposit of earthy matters which have been left behind by the fluid substances that are transmitted through them. If this were so the tissues would become choked up and hard and no longer able to perform their several functions, the secretions could not be developed, and life must cease.

Notes in Brief.

Notwithstanding the ill success of the Panama Canal, where work is now almost stopped, the vast machinery and appliances lying neglected, there seems to be no lack of projects on foot for more ship canals. A canal is proposed to connect the Atlantic with the Gulf of Mexico across the peninsula of Florida, and in Europe a canal is projected across the north of Italy. In Scotland it is proposed to join by a canal the Firths of Forth and Clyde, and no fewer than three routes are before the promoters, the final choice of which has yet to be made. One plan, which would cost two millions sterling, has the object of enlarging the existing Forth and Clyde Canal into a waterway for large ships. The other routes would pass through Loch Lomond, and, doubtless, thus vex the soul of Mr. Ruskin.

Dr. M. C. Cooke, M.A., LL.D. is engaged on a new number of the International Scientific Series on the *Fresh Water Algæ*, which is to appear early next year.

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A NEW microscope has been invented by Dr. E. Schulze, director of the Zoological Institute at Berlin, and is called a "horizontal microscope." It rests on a perpendicular stand, and its chief feature is an aquarium, which contains the object to be examined. The aquarium is a cavity made of panes of glass, lit by reflected light from a movable mirror. The cylinder of the microscope can be brought into three different positions by means of screws, and moved in all directions to enable an examination of every part of the object. For watching small moving animals this new instrument will be most useful.

ONE of the "sights" of the late Paris Exhibition was a remarkable model of the Earth, one-millionth of the size of nature. The gigantic model was constructed under the direction of a committee of scientists, and consisted of a huge iron skeleton covered with cardboard and plaster. By means of a winding staircase the visitor could start at the North Pole and traverse the whole of the world, obtaining perfect views of every country and the expanse of ocean. All the more recent discoveries of geographical science were duly recorded, even to the data established by Stanley's last expedition.

PAINTERS and artists are now beginning to recognise the "fairy tales of science" and their artistic value. With lunar landscapes we are already familiar, but in Paris were recently exhibited pictures depicting scenes in the lives of the pre-historic inhabitants of this planet. One canvas showed the entrance to a cave of the Stone Age, with the hunter of the period returning to his "home" only to find it occupied by a lion, and his wife lying dead beneath the animal's paws. Scenes of this kind are likely to add some variety to our art galleries in the future.

AT a largely-attended public meeting, held in Manchester, it has been decided to promote a series of tests of smoke-preventing apparatus, with a view to the ultimate prevention of the emission of smoke from works and maunfactories, and so purify the air of our great centres of industry.

AT a well-attended meeting held on November 6th, at the University College, a Physical Society was established in Liverpool. Dr. Oliver J. Lodge, F.R.S., was elected first president, Messrs. Isaac Roberts, F.R.A.S., F.G.S., and A. Norman Tate, F.I C., F.C.S., &c., vice-presidents; A. Carey, hon. treasurer; Thomas Tarleton, hon. secretary; and the following gentlemen as members of council, viz.:—E. H. Culley, M.A.; Rev. F. F. Grensted, M.A.; Wm. Hewitt, B.Sc.; George Higgs, A. Bromley Holmes, George Holt, J.P.; Jas. L. Howard, D.Sc.; R. C. Johnson, F.R.A.S.; C. A. Kohn, D.Sc., Ph.D.; E. K. Muspratt, J.P., F.I.C., &c.; Geo. Tate, Ph D., F.I.C., &c.; Isaac C. Thompson, F.L.S., F.R.M.S. The meetings will be held at University College, and the first will be on the third Monday in December, when Professor Lodge will deliver his inaugural address. Over 80 members have already been enrolled.

THE associated *soirée* of the literary, scientific, and art societies of Liverpool, which has been almost an annual institution for some years past, has been postponed until January 8th next, when it will be held in St. George's Hall. Mr. E. Muybridge is one of the lecturers engaged for the occasion.

THE Geographical Society's collection in Regent's Park has been enriched by the acquisition of a fine young female Burchell's Zebra (*Equus Burchelli*), so that the society now has a pair of that species. They already possessed a pair of the rare species of true zebra (*Equus zebra*). Under the advancing tide of immigration in Africa both these beautiful representatives of the horse tribe are, it is said, rapidly becoming extinct.

THE Astronomer-Royal for Scotland has called attention to the large white halo seen on 14th October round the moon, in which appeared at times two mock moons, with rainbow colours. The appearance was due to a layer of ice-particles in the atmosphere at some considerable height above the earth's surface.

THE Western Microscopical Club publishes, in a neat *brochure*, an abstract of their proceedings for the session 1889. The club is entirely informal, having no officers, except a secretary, and meets at the houses of its members, the number of whom is limited to twenty active and twenty honorary. Among the subjects dealt with at these pleasant gatherings, and duly recorded in the *Proceedings*, were:—"Ants," by F. P. Pascoe; "Organs of Hearing," W. H. Lamb; "Photo-Micrography," Dr. J. Foulerton; "Vitreous Rocks: Their Structure and Devitrification," G. S. Boulger; and "The Origin of Floral Structure," by the Rev. G. Henslow.

IT is proposed to erect in Manchester a suitable memorial to the late Dr. James Prescott Joule, and a committee has been appointed by the Council of the Manchester Literary and Philosophical Society to initiate and carry out the movement.

ON 8th November the Stockport Technical School was formally opened by the Mayoress of the town. The school embraces class-rooms, chemical laboratory, lecture theatre, joinering and engineering room, and art rooms. Sir John Lubbock made a characteristic speech on the occasion.

IN an address on the better study of geography recently delivered in Manchester, Prince Krapotkin regretted that in the study of geography in schools the faculty of imagination was so largely left out of account. The teacher should first deal with general ideas, then would come locality and mapping, and then he would have the pupil interested in the life of nations, their laws, institutions, and history. One missing feature in English education was a teacher who would gather up the threads of many sciences and weave them into a continuous whole: this, he thought, was the work of the geographer.

FROM the "provisional list of geological photographs" printed in another column it will be seen that the British Association Committee is now at work on the collection and registration of photographs illustrating the geology of the British Islands. The scheme has met with warm support from some of the leading geologists of this country and of America, and, owing to the recommendation of Professor James Geikie, F.R.S. (who is chairman of the committee), a grant of £10 was obtained from the Association for the first year's work. The list speaks for itself as to its usefulness. Forms have been prepared for noting the essential details of sections photographed, and a circular containing all necessary instructions can now be obtained.

AMONGST the local societies who have been most active in prosecuting this new aid to geological records are the societies of Yorkshire. It is now proposed to carry out this work more effectually by a local committee acting in conjunction with the British Association Committee, under the auspices of the Yorkshire Naturalists' Union. A similar committee has been formed by the East Kent Natural History Society, and societies in other parts of the kingdom will doubtless find this the most convenient method of conducting the systematic photography of rock-sections. The idea has even spread to America, and Dr. Kemp, of the Cornell University at Ithaca, New York State, is pushing forward with a scheme on the lines of the British Committee, which he will place before the newly-organised Geological Society of America at their December meeting.

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THE Annual Distribution of Prizes to the successful students of the Liverpool Science and Art Classes took place on 9th November, under the presidency of Mr. James Samuelson. The Annual Report of the Classes, read by the Hon. Principal (Mr. A. Norman Tate, F.I.C.), showed that the results of the year's work were very encouraging. Classes were conducted in sixteen local centres. In science there were 685 entries for study, 459 entries for the government examination and 371 successes, showing, as against the previous session, an increase of 147 in entries for study, an increase of 82 in the number examined, and an increase of 89 successes; the total percentage of successes being 80·8. In art there were 127 entries for study, 157 for examination, and 104 successes, including 11 marked excellent, showing an increase of 18 entries for study, an increase of 63 in number examined, and an increase of 21 in successes. The prizes were distributed by Mr. W. Woodall, M.P., member of the Royal Commission on Technical Education, who gave an address, in which he referred to the necessity of a sound system of elementary education to precede technical or higher instruction. On the Continent this necessity was recognised in all stages of education. What was wanted was technical education from the earliest standards, and he urged that drawing should be taught as universally as writing was in the elementary schools. The meeting was also addressed by Mr. E. K. Muspratt (chairman of the classes), Mr. S. G. Rathbone (chairman of the School Board), Mr. G. Melly, and Mr. Matkin.

THE opening by Lady Walker of the new Walker Engineering Laboratories, at Liverpool University College, was attended with great success. The building has been erected and equipped at a cost of £20,000, generously defrayed through the munificence of Sir A. B. Walker, Bart. All the latest appliances and engineering models are contained in the new department of University College, which is fitted upon a very complete scale, and these additional facilities, now at the disposal of the authorities, will doubtless effect an increase in the number of students.

THE Manchester Association of Anglers had an interesting scientific address from Professor W. C. Williamson, on the occasion of a recent visit to Owens College. The Professor described some of the primeval and inherited features of fishes, which, as he said, was a big subject. It, however, seemed to please the disciples of Isaac Walton, who wished to be favoured with another address, bringing them a little nearer to our own time. What they learnt would doubtless cause them to take greater interest in the fishes they caught than they had done before.

HUDDERSFIELD TECHNICAL SCHOOL.—The geologists of Huddersfield closed the season with some excellent excursions. One of the localities visited was Shepley, where some fine sections in the coal measures were seen *en route*. A small party spent a few enjoyable days at Barmouth, in Wales, where the surrounding natural scenic attractions, opportunities for glacial study, the fine sections of Cambrian and Upper Silurian rocks in the vicinity, and the slate quarries near Dolgelly, all afforded scope for investigations of the highest interest.

IN that elegantly-printed journal, now unhappily defunct, entitled the *Manx Note Book*, appeared a valuable series of articles, contributed by Mr. A. W. Moore, M.A., on Manx surnames, which contained much that was of interest in relation to the personal nomenclature of the Isle of Man. These papers, supplemented by others, are about to be published by Mr. Elliot Stock, London. The volume will contain an introduction on the phonetic relation of the Manx tongue to Irish and Gaelic, by Professor Rhys, and will be invaluable to philologists generally and students of Manx lore in particular.

ON the 28th October the formal opening of the new Technical School at Bingley took place, by Mr. W. Papworth, F.R.I.B.A., Master of the Clothworkers' Company. The building is two stories high, and contains all modern arrangements necessary for the teaching of chemistry and the arts and sciences.

MESSRS. DULAN & Co. announce that they will have ready for publication early in December a catalogue of British fossil vertebrata, by Messrs. A. S. Woodward, F.G.S., and C. Davis Sherborn, F.G.S. The volume, which is to consist of about 350 pages, will give the results of researches upon the British fossil vertebrates since the time of Linnæus. The nature of each type specimen will be specified, and, wherever traceable, the collection or museum where it is now preserved. In furtherance of this work the authors have visited most of the principal collections of fossil vertebrata, both public and private. The subscription price of the work is 10s. 6d.

AMONGST those recently elected Fellows of the Geological Society of London is Mr. T. Shilston, of Newcastle-on-Tyne, whom we remember as one of those who took an active part in the formation of the Liverpool Geological Association.

Museum Notes.

THE Central Society of Professional Labour, Paris, is busy in the development of an Industrial and Commercial Museum. Many exhibits have already been collected in the galleries of the Commercial High School, which has been placed at its disposal by the Paris Chamber of Commerce, and a special building, in the centre of the city, will be devoted to the purpose.

ON behalf of certain German museums, Herr Frühstorfer, a naturalist of Berlin, has spent three months in making an entomological tour in Ceylon. He has brought home a gigantic collection, including 25,000 beetles, 7,000 butterflies, 3,000 *orthopteras* (locusts), 3,000 dragon flies, and 1,000 spiders and centipedes. Among his most valuable specimens are the leaf-butterflies and locusts, and the long-horned beetles and mantidæ, besides which Herr Frühstorfer has secured a goodly number of snakes and other reptiles. He was accompanied by fourteen assistants, who collected for him in all parts of the island. The foregoing co-operative principle, as regards the collection of specimens for a number of museums, might with advantage, be adopted by some of our institutions of a similar character in this country.

IT has been resolved to establish in Berlin a Bismarck Museum, to be devoted to a collection of books, pamphlets, portraits, biographies, and all objects having relation with the famous chancellor. Many interesting objects have already been collected, and the whole world is invited to contribute to this novel historical museum.

IN connection with the Liverpool Geological Association a series of monthly practical demonstrations has been arranged in the Liverpool Public Museum on Saturday afternoons as follows:—Nov. 9, Rev. S. Gasking, on "Fossil Fishes;" Dec. 14, Mr. C. E. Miles, on "Gold;" Jan. 11, Mr. A. Norman Tate, F.G.S., on "Contrasts in the Mineral Kingdom as Dependent on Chemical Composition;" Feb. 8, Mr. F. E. George (sec.), on "Jet."

THESE meetings are quite distinct from the Museum lecturettes on Monday evenings, given under the auspices of the Museum and Arts Committee, which have this season been very successful. During November Mr. J. Chard lectured on "Centipedes, Millipedes, and Scorpions," in the Bird-room (No. 5); Mr. W. J. Argent on "Musical Eyes and Ears;" Mr. Lutzwinnig on "Gold Nuggets;" and Mr. Wm. Hewitt, B.Sc., on "Coal."

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AN interesting exhibition of gas cooking and heating stoves and other appliances has been opened in the grounds of the Peel Park Museum, Salford. At the opening ceremony, Mr. H. H. Howorth, M.P., referred to the exhibition as a credit to the borough. Lectures on cooking were given each day of the exhibition by Miss Young, of Warrington.

BOOTLE MUSEUM.—With the object of making known to the inhabitants of the borough the educational advantages of their library and museum, a "circular of information," drawn up by the curator, Mr. J. J. Ogle, has been issued and distributed. It contains particulars of the library, with news-room and students' room; science classes in nine subjects, under the Science and Art Department; an extended course of free lectures on popular subjects; system of home reading, after the syllabus of Cambridge University; and a programme of free museum addresses. All curators should see a copy of this well-designed *brochure*, which should be found to be a useful means of spreading the benefits of such institutions far and wide.

THE following are the titles of the museum lectures arranged at Bootle, given alternately by the curator (Mr. Ogle) and Mr. Councillor J. Vicars:—Nov. 14, "The Structure and Growth of Wood;" Nov. 28, "Cuttle Fishes;" Dec. 12, "How to Start and Stock an Aquarium;" Dec. 19, "Snails;" Jan. 9, "Some Extinct Animals;" Jan. 23, "Sea Slugs and Pteropods;" Feb. 6, "Wild Flowers of the District;" March 6, Mussels and Cockles." On Feb. 20 Mr. G. F. Moore will lecture upon "Hands and Feet."

WITHIN the last twelve months great progress has been made with the collections in the Bootle Museum, the chief features of which are the collection on the upper floor of over 2,000 British and foreign birds, the Gregson Collection, comprising economic products, minerals, rocks, fossils, insects, shells, and a collection of coins and seals. This was gathered together by three generations of the Gregson family, of Aigburth. The bulk of the collections in this museum was purchased from the Royal Institution, Liverpool, out of funds furnished by Lord Derby and the trustees of the Dawson Bequest.

AN instalment of important Indian fibres, required by the Indian Office for the presentation to the Museums of the Royal Botanical Gardens at Kew and Edinburgh, has been despatched under the direction of the Economic Museum at Calcutta. The Chambers of Commerce at Dundee and Manchester are also to have the privilege of participating in these spoils from the far East.

THE draft Library and Museum Bill, by J. J. Ogle and H. W. Fovargue, which gained the prize at the recent Library Conference, contains much that is of interest to curators of museums, as well as librarians. Some of the leading features of this Bill are here summarised:—

All existing library laws are repealed. Districts, whether adjoining or not, may amalgamate to carry out the Act. Borrowing powers are limited to a sum not exceeding one-fourth of the library rates capitalised at the rate of twenty years' purchase of such sum, to be repaid by not more than fifty annual instalments. A special inauguration rate of 1d. in the £ may be levied for the purchase of books and objects, and an annual rate varying from 1d. to 2d. for the purposes of the Act. All libraries, museums, and art galleries are to be free, and the buildings exempt from local rates. Libraries are to have the power of demanding free copies of government and of local official publications.

IN a paper also read before the Librarians' Congress, Mr. Alfred Lancaster, librarian of St. Helens, referred to the important aid such institutions afford to the cause of technical instrnction. In St. Helens the principal industries are in glass, chemicals, and metals; books dealing with these subjects are, therefore, procured. Librarians might operate with teachers of science classes, and with masters, managers, and foremen of works with a view to obtaining for the library the best and most serviceable books on scientific subjects. Decorators, designers, and others visit the reference department and look over fine art works with a view of getting new ideas to help them in their work. Technical periodicals and trade journals are also found useful.

AN exhibition of island products is to be held at Kingston, Jamaica, in 1890. The co-operation of all who are interested in the island, including manufacturers of machinery for preparing native products for the European market, is desired, and it is hoped that a valuable museum of economics may be ultimately formed.

Foreign Jottings.

A NORWEGIAN GEOGRAPHICAL SOCIETY has been constituted at Christiania.

THROUGH the instrumentality of the Norwegian inspector of fisheries, Captain Juel, a parcel of Norwegian trout ova was forwarded last March to the fish hatchery establishment at Malvern Wells, in order to ascertain whether the trout was suitable for acclimatisation; and it appears that the experiment has been a great success, the Norwegian fry having grown remarkably rapidly, and are said to be in a finer condition than the native.

DR. FRITHJOF NANSEN has just visited Stockholm and lectured before the Swedish Royal Geographical Society, on which occasion he received from King Oscar, in person, the *Vega* gold medal, struck in honour of the expedition of that name, and which has only been awarded to six other great explorers. He brought with him some samples of air taken in Greenland at an altitude of 10,000 feet, for examination by the celebrated Swedish physicist, Professor Petterson.

THE following telegram has been received, dated Minusinsk, from Dr. A. O. Heikel, leader of the Finnish expedition exploring the district of the Yenissei:—"Have examined barrow with inscription at Taschebá. Found gold and iron objects. Jadrintzew has discovered the site of Jengisk-Khan's capital in Mongolia, with Yenissei and Chinese inscriptions." The barrow examined by Dr. Heikel at Taschebá, an arm of the river Abakan flowing into the Yenissei, is situated about 30 versts west of Minusinsk. The inscription upon one of the slabs raised around it, discovered by Drs. Aspelin and Snellman, in September, led to Dr. Heikel's examination. The inscriptions discovered by his companion in Jengisk-Khan's capital may perhaps lead to the disclosure of the key to the interpretation of Yenissei incriptions. Anyhow, there is no doubt that the journey of these *savants* will yield highly important ethnographical results.

THE rising of the shores of the Baltic is a problem sorely puzzling geologists. Since 1837 the hydrographical office of Russia has had its attention drawn to the rising of the shores of the Gulfs of Bothnia and Finland, and many marks have been made upon rocks in order to ascertain its extent. The results of observations of these rock-marks have now been collected, and it appears that during a century the coast at Aspö rises at the rate of 20·3 inches, at Lehtö 11·5, Kotka 26·7, Sveaborg 22·8 and 25·1, Hangöudd 33·7, Tverminö 36·2, and Gloskär 12·2 inches. It has, therefore, been found that the popular belief that the coast of Finland rises about three feet during a century is nearly correct.

BEARING upon the above is the following telegram received from a Russian explorer, Tadrintsew, who has also just visited these parts:—"My expedition is returning. We have reached the height of Orkhon, where we discovered several ancient Mongolian palaces, two old cities, and an ancient royal burial place with monument and inscriptions. We have taken copies of numerous hieroglyphics."

DURING the past summer several German museums despatched the well-known Berlin entomologist, Frühstorfer, to Ceylon, in order to collect specimens of that island's entomological fauna, and the result has been very gratifying. He has collected some 25,000 beetles, 7,000 butterflies, 3,000 grasshoppers, 1,000 spiders, &c. It is said that the collection contains many specimens which are not in the museum at Colombo. In a hilly district he found some splendid specimens of the family of the rare Cetonides, and a specimen of the "soldier" grasshopper, the colour of which is purple, with golden specks in rows.

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THE Urania observatory in Berlin has received a new 12-inch refractor, which is the largest in Prussia.

THE following is a *resumé* of the archæological work done in Italy during the autumn. Excavations have been carried out at Bondena, Ferrara, Lozio, in the neighbourhood of Brescia, in Via Portuensis, on the right bank of the Tiber, and at Civita Lavinia, near the spot where the famous temple of Juno stood, and at Carsoli. At Via Portuensis seven well-preserved portrait busts were found, together with a chain of gold, pearls, and agates. At Carsoli a female marble statue was excavated, whilst near the *propylæ* of Selinunt traces of a temple were found, similar to those of Eleusis, Samos, and Acropolis. In the neighbourhood of Rome excavations have been carried out at the Villa Caprara, in order to find material for solving the question of the development of culture in Italy. In the uppermost layer were found remains of houses from the Roman era, below that Gallic graves, and below that again early Italian graves. Professor Bizzio has excavated 60 graves from the oldest period in the lowest layer at Porta St. Isaia.

Apropos of the question of forest culture, recently referred to in *Research*, it may be of interest to state the magnificent forests of Servia are threatened with extinction. During Turkish rule these forests were certainly not much looked after, but they remained intact. However, since Servia has become independent, farmers owning a few acres of land have cut the timber down wholesale in order to turn it into money, and many a fine forest with precious woods has already disappeared. Cattle, too, graze where they list, and contribute to the damage. Now and then the Government seems to be inclined to protect them, but it ends in an attempt. Coals are not used for fuel, only wood. The walnut trees, in particular, attain great magnificence in Servia, and Austrian merchants send numerous agents thither to buy all they can lay their hands upon. From the district of Toplitza alone 500,000 lbs. of walnut timber is exported annually to Austria. It is also said that the climate is becoming more rigid in consequence of the clearing of the forests.

Our Portrait Gallery.

XVI.—HENRY CLIFTON SORBY, LL.D., F.R.S., F.G.S., &c.

HENRY CLIFTON SORBY, of Broomfield, Sheffield, son of Henry Sorby, of Woodbourn, near Sheffield, was born May 10th, 1826; and, on the death of his father in 1846, was left in such circumstances as to be independent of a profession or business. From his boyhood he had applied himself to the study of various natural sciences, commencing with natural history, geology, and chemistry, but later he devoted himself more particulary to the investigation of the structure of rocks, being the first to prepare thin microscopical sections suitable for high magnifying powers. His work on this subject has led to much inquiry by geologists and mineralogists into the minute structure of rocks and minerals, and undoubtedly, in many ways, has had considerable influence on geological thought and action. His more important papers connected with the subject are *On the Origin of Slatey Cleavage*, published in the *Edinburgh New Philosophical Journal*, 1853; *On the Microscopical Structure of Crystals*, in the *Journal of the Geological Society*, 1858; *On the Structure and Origin of Limestones* (Anniversary address to the Geological Society of London, 1879); *On the Structure and Origin of Non-Calcareous Stratified Rocks* (annual address to the Geological Society of London, 1880); and *On the Comparative Structure of Artificial Slags and Erupted Rocks* (Presidential address to the Geological Section of the British Association, at Swansea, 1880).

Subsequently he devoted much time to the development of spectrum analysis along with the microscope, and to the application of that method to the study of minerals and the colouring matters of animals and plants. We understand that he hopes to publish more particulars on this subject, and to show what important problems still remain for investigation; but already his labours at micro-spectroscopy have been of immense value, and have led to the employment of the micro-spectroscope in many important researches, and have placed at the disposal of the physician, chemist, metallurgist, and others methods of investigation of great service in their ordinary work. Amongst other papers on this subject may be named those on the detection of blood-stains, and an important memoir *On Comparative Vegetable Chromatology*, read before the Royal Society in 1873, in which he dealt with the application of the micro-spectroscope to the colouring matter of plants.

Somewhat later he was much occupied in the study of the microscopical structure of iron and steel with high powers, and in this direction opened up another wide field for interesting and serviceable investigation, in which he not only proved himself a successful worker, but showed also how very much more may yet be done in connection with variations in chemical composition, and the application of the method to the details of manufacture. He further dealt with the microscopic characters of meteorites, and on this subject delivered an interesting address at South Kensington Museum, in 1877, which was published in *Nature*, vol. xv.

So far, most of this work was carried on by quiet study at home, but the death of his mother in 1874, with whom he had lived for 28 years, made a more active life possible. In 1878 Mr. Sorby decided to live through the summer on board his yacht "Glimpse," and since then his investigations have, to a large extent, been such as can be successfully carried out under these circumstances, and also when visiting places of interest on shore. Amongst other subjects may be named the the habits and local distribution of marine animals, and the temperature and density of the water of the sea and estuaries, of which an account has just been published in the *Scottish Geographical Magazine*. In 1882 and 1883 he was much occupied in studying the water and deposits in the Thames, in connexion with the Royal Commission on the drainage of London. In addition to these subjects, he has investigated the changes in physical geography that have occurred in the historical or somewhat earlier period, and certain branches of archæology connected therewith. This work has led to a much more extended study of Roman, Saxon, and Norman antiquities, and the application of scientific methods to archæological questions,

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HENRY CLIFTON SORBY, LL.D., F.R.S., F.G.S., &c.;
BROOMFIELD, SHEFFIELD.

From a Photograph by E. Peakome, Sheffield.

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and also to the study of early church architecture, and to early English art, as seen in illuminated manuscripts.

In addition to his papers and addresses already alluded to may be mentioned those *On the Physical Geography of the Old Red Sandstone Sea of the Central District of Scotland*, published in the *Edinburgh New Philosophical Journal*, 1856; another paper in the same journal, 1857, *On the Physical Geography of the Tertiary Estuary of the Isle of Wight*; and many others of great scientific value, all of which show with what great patience, delicate and careful manipulation, and good judgment his work has been performed. They are written in a style at once clear and concise, and suggestive of further thought and work.

Mr. Sorby was elected a Fellow of the Geological Society in 1850, and of the Royal Society in 1857, and is a foreign member of the Mineralogical Society of St. Petersburg, and one of the 18 foreign members of the Academy of the Lynxes in Rome, and a member of many other societies. He was president of the Royal Microscopical Society in 1875, 1876 and 1877, and of the Geological Society in 1878 and 1879, and of the Geological Section of the British Association in 1880. He received the Wollaston Medal of the Geological Society in 1869, a Royal Medal of the Royal Society in 1874, and in 1872 the Boerhaave Medal of the Dutch Society of Sciences, being the only one so far awarded for geology and mineralogy. The University of Cambridge conferred on him the honorary degree of LL.D. in 1879.

Dr. Sorby has not, however, confined his labours entirely to scientific work, for much of his time has been, and is still, devoted to the educational and other institutions in his native town. He is president of the Council of Firth College, chairman of the Technical School, president of the School of Art and of the Mechanics' Institute and director of the Gas Company. Indeed, he is not only a successful investigator and exponent of science, but one who helps the world's work in many useful directions.

British Association, 1889.

Gleanings from the Sections.

Fishing by Electric Light.

Prof. W. A. Herdman, D.Sc., F.L.S., read a paper on "The Electric Light as a Means of Attracting Marine Animals." The first application of this important method of collecting appears to have been made by the United States Fish Commission in 1884, on board the steamer "Albatross." On that occasion an arc lamp was merely suspended above the surface of the water, and it was found to attract amphipods, squids, and young fish to the surface. In the following year the same naturalists experimented further by lowering an Edison incandescent lamp into the water, with similar good results. The Fish Commission do not give any details in regard to the animals collected, nor any comparison between the contents of illuminated and ordinary tow-nets worked at the same time. The next submarine electric light experiments were those carried out by the Liverpool Marine Biology Committee in May, 1888, on board the steamer "Hyæna" during a three days' dredging expedition in the Irish Sea. The "Hyæna," kindly lent by the Liverpool Salvage Association, is provided, for wrecking purposes, with the following electric light installations:—A Gwynne vertical engine, of 6 nominal h.p., running at 300-400 revolutions per minute, works a Phœnix compound wound dynamo, with an effective output of 5,980 Watts (65 volts 92 ampere), at 1,000 revolutions per minute. There are two Pilsen arc lamps of 3,000 nominal c.p. each, which can be used on deck or at masthead or on the side of the ship; four Edison-Swan submarine incandescent lamps of 100 c.p., and ten of 16 c.p. each. The dynamo, being compounded, allows the arc and incandescent lamps to be run together with perfect ease by the use of a resistance of about .5 of ohm in the arc-light circuit. The submarine lamps are fitted in strong circular annealed glass protectors, and can be lowered to any required depth in the water by means of a special waterproof flexible cable, made of 260 strands of fine copper wire, covered with thick gutta-percha and hemp. The arc lamps require from 25-30 amperes, and the submarine lamps 4.5 amperes, so that there is ample power when the whole installation is running. This apparatus was first used for biological purposes in Ramsay Bay on the first night of the cruise. After dark one of the large arc lamps was hoisted a few feet above deck, so as to allow work to be carried on almost as easily as during the day. We then arranged one of the submarine incandescent lamps in the mouth of a tow-net so as to be just well within the iron ring, and yet not too deeply in the net, the object being to illuminate the entrance to the net and not the middle or tail end. This illuminated net was let down to a depth of three fathoms, and at the same time another tow-net without any light was let down to the same depth over the other side of the ship. When, after half an hour, the nets were hauled in, as the one with the electric lamp approached the surface numerous crustacea were noticed accompanying it, and darting about in the bright light. This tow-net, when emptied into a glass jar of sea water, was found to have contained an abundant gathering, consisting mainly of crustaceans, while the net in the dark on the other side of the ship had practically nothing. The two nets were then put out again, this time to a depth of 6 fathoms, and at a greater distance from one another, with the same general results as before. The two experiments showed conclusively the effect of the brilliant light in attracting the free-swimming animals, the difference between the contents of the two nets being on both occasions most marked. Consequently on the second night in Port Erin Bay, both nets were illuminated, and, while the one was let down close to the bottom at a depth of five fathoms, the other was kept at the surface. This experiment was tried three times, with the same result each time. Both nets contained abundance of animals, but the bottom and surface gatherings differed greatly in appearance and in constitution—the net from the bottom containing mainly large amphipoda and cumacea, while that from the surface was characterised by the abundance of copepoda. In April, 1889, the steamer "Hyæna" was again placed at the service of the Liverpool Marine Biology Committee for a five days' cruise, and the opportunity was taken advantage of to make a further series of experiments with nets illuminated by the electric light. On two successive nights in Port Erin Bay, after dark, both the large arc lamps were lit up and were suspended half-mast high, so as to throw a strong glare upon the water at the sides of the vessel. Tow-nets provided with submarine lamps were then used both at the bottom (six fathoms) and at the surface, and an ordinary tow-net was dragged round and round the ship in the brightly illuminated water. All of these nets gave abundant gatherings, consisting mainly of copepoda, amphipoda, schizopoda, and cumacea, and differing most markedly from the gatherings taken in the same spot during the daytime without the electric light. In this case there was no difference noticed between the contents of the bottom and surface nets, both containing abundance of cumacea. This difference from the previous year's results was probably due, I think, to our having a much more powerful surface light (6,000 c.p.), which had been shining for at least half an hour before the tow-nets were put over, with the result that the cumacea and other bottom crustacea were attracted to the surface from a depth of six fathoms. On the last day of the cruise we took a gathering successfully with an illuminated tow-net from a depth of 30 fathoms, the deepest water on our course from the Isle of Man to Liverpool. The results of these experiments in Liverpool Bay have been such as to show conclusively that the submarine electric light is an important addition to the collecting methods by the marine biologist, and one which ought certainly to come into extensive use in the future. As to the practical application of this method to fisheries, although there can be no doubt that the electric light acts powerfully in attracting many free-swimming animals, and especially the crustacea, I think there is no good evidence that it attracts marine fishes; and, although more experiments are required before the matter can be considered as settled, I am inclined at present to agree with the opinion which has been expressed by some of the American investigators, that the method is of more value to the scientific biologist than to the practical fisherman.

Copepoda in Liverpool Bay.

Mr. Isaac C. Thompson read a paper on "Some New and Rare Copepoda Recently Found in Liverpool Bay." The paper was supplementary to one read by the author at the Manchester meeting of the association in 1887, in which several species of copepoda new to Britain were referred to. The investigation of this class of microscopical crustacea had been actively continued in connexion with the scheme of the Liverpool Marine Biology Committee, instituted by Professor Herdman five years ago for investigating the fauna of Liverpool Bay, and of whose researches a second volume has recently been published. Ninety-four marine

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species of copepoda have already been found in the district, the paper referring especially to eleven of these which are new to Britain, four being new to science. The establishment of the biological station on Puffin Island at the entrance to the Menai Straits had proved of immense benefit in the investigation of marine fauna. By the use of the electric light while cruising in the steamer "Hyæna," belonging to the Liverpool Salvage Association, many valuable species of copepoda and other free-swimming crustacea had been taken. The paper dealt with the geographical distribution of copepoda and their gregarious habits. Their presence or absence, as influenced by commerce, formed a valuable subject of inquiry, from their value as marine scavengers and purifying agents, for, without them, waste and putrefaction would be deadly enemies, and our fish supply would be alarmingly affected, if not annihilated.

Secretion of Carbonate of Lime by Animals.

In a paper read by Mr. Robert Irvine, F.C.S., Royston, Granton, and Dr. G. Sims Woodhead, F.R.C.P., Edin., on this subject, it was stated that hens supplied with any salt of lime produce normal egg-shells composed of carbonate of lime. They cannot make shells from magnesium or strontium carbonate. Crustacea, such as crabs, cannot assimilate sulphate of lime from the sea-water to form their exo-skeleton. They can form their shells from calcium chloride. In the egg-shell the organic and inorganic material are both secreted by cells separated from the epithelial cells. In the crab-shell, the organic material (chitin) remains attached to the epithelial cells, and in this the lime salts are deposited, probably by a process of dialysis, whilst, in the case of bone, the cells are not epithelial in character, the matrix, though separate, is closely associated with the cells, especially during its formation, and the lime is deposited in the matrix apparently by a process of dialysis. Phosphoric acid, combined with alkalies and alkaline earths, acts as the carrier of the lime salt to the secreting cells. While in the blood, the lime salt is as a phosphate; it may be thrown out mostly as carbonate on meeting nascent carbonic acid at the secreting cells. Lime salts, of whatever form, are deposited only in vitally inactive tissues, such as bone matrix, chitin, or tissues that have undergone degeneration. Although the tissue be dead, deposition may go on.

Importation and Colonisation of Parasites.

Mr. Harmer read a paper contributed by Mr. C. V. Riley, Ph.D., entomologist to the United States Department of Agriculture, on "The Importation and Colonisation of Parasites by Other Natural Enemies of Insects Injurious to Vegetation. Dr. Riley said the encouragement of the natural checks to the increase of insects injurious to vegetation might be of a twofold nature. It frequently happened that an indigenous species was found to have certain parasites in only a portion of the country which it inhabits. In such cases, where it is practicable to transport the parasites, a great deal of good may be accomplished. But this intentional distribution of the parasites or natural enemies of an injurious insect from one part to another of its native country was by no means to be compared in importance with the introduction of such parasites or enemies from one country to another, in which the injurious species has obtained a foothold, without the corresponding natural enemies which serve to keep it in check in its original home. The object of the present note was to cite an illustration of artificial introduction on a large scale, which had already been productive of great good. The orange groves of Southern California have suffered for some years from the attacks of several insects, but particularly of a very pernicious scale-insect, *Icerya purchasi*, Maskell. After careful researches, the author ascertained that the insect was, without much question, a native of Australia, and had been artificially introduced, not only in Southern California, but also in Cape Colony in South Africa, and probably in New Zealand; also that in its native home it rarely did serious damage, being kept in check there by various natural enemies and parasites.

Artists' Colours.

Dr. A. P. Laurie, in reading a paper on "Artists' Colours," said he had been inquiring as to the mixtures of oils and colours and the methods of manufacture, the colours used by the old masters, and the literature that showed the recipes, with the view of explaining the fading of colours. Looking into old Italian literature, he found much that bore on the subject, though it was often of a more curious than practical nature. One point in relation to the old masters, however, that came out was the large amount of vegetable colours they used, many of which were not used by modern painters. Again he had investigated, in some degree, the ordinary methods of manufacturing colours, and his researches showed the need that there was for looking closely into the method of that manufacture, before choosing colours for very important pictures. He illustrated this point with several samples of colours, showing the variation in different makes of the same colour. As to vermillion, for instance, he indicated the modern methods of manufacture, and added that in some specimens sulphide of potassium was discovered. In Prussian blue, he showed by example that it would never do to compare two samples made by such different methods as there were in use. As to oils, he pointed out that one of the most valuable oils used by the old masters was walnut oil. This was a field of research just begun, and, as it dealt largely with trade secrets, it was obvious that it could only be slowly pursued.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between October 16th and November 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	Highest (November 8th)	30·52	Inches.
,, ,,	Lowest (October 20th)	29·11	,,
,, ,,	Mean	29·934	,,
,, ,,	,, for 22 years October	29·879	,,
,, ,,	,, ,, November	29·862	,,
Temperature	Highest (November 7th)	58·8	Deg. F.
,,	Lowest (November 12th)	33·1	,,
,,	Mean	47·4	,,
,,	,, for 22 years October	49·3	,,
,,	,, ,, November	43·3	,,
,,	,, of Evaporation	45·4	,,
,,	,, ,, for 22 years October	46·8	,,
,,	,, ,, ,, November	41·3	,,
(*b*) Rainfall	Amount	2·409	Inches.
,, ,,	,, Mean for 22 years October	3·630	,,
,, ,,	,, ,, ,, November	2·826	,,
,,	Number of Days on which Rain fell	19	
,,	Greatest fall in 24 Hours (November 14th)	0·396	Inches.
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	8·4	
,,	,, ,, for 22 years October	7·1	
,,	,, ,, ,, November	6·7	
(*c*) Wind	Velocity, Greatest (November 1st)	46	Miles.
,,	,, Least (October 16th)	1	,,
,,	,, Mean Hourly	15·4	,,
,,	Greatest Pressure on Square Foot (Nov. 1, 6-55 a.m.)	21·8	Pounds.
,,	Direction at time of Greatest Pressure	SW	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
105	98	125	100	95	173	34	14	0

Notes.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 101 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed six inches above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

The Weather.

October 15 to November 14, 1889.

From the 15th to the 20th of October the barometric pressure fell 0·668 in.; air humid, sky overcast, and occasional drizzling rain; temperature normal and equable. The means for the week were:—Barometer 29·529 in.; mean temperature (corrected for daily range) 47·25°; relative humidity 92%; total rainfall 1·347 in.; bright sunshine 0h. 15mins.; wind Easterly. From the 22nd to the 31st pressure was very irregular, with range of 0·769 in.; temperature varied from 49° on the 22nd to 42·1° on the 26th. Means:—Barometer 29·914 in.; temperature 45·69°; humidity 85%; total rainfall 0·601 in.; sunshine 12 hours; wind South Westerly.

The weather during October was dull and very humid, but mild and equable in temperature. Autumn flowers held on well through the month, and numerous instances were observed of primroses, buttercups, &c., being in flower in the neighbourhood. The season has been favourable for the maturing of the scales and buds of deciduous trees and shrubs, thus giving promise of abundance of bloom and flowers for next year. The monthly mean of barometric pressure, 29·670 in., is the lowest recorded here since the memorable December of 1886, with a range of 1·412 in. and 12 oscillations. The corrected mean tempera-

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ture, 46·35°, was slightly above the average, and range low. No frosty nights recorded, whereas in 1888 frost occurred on 8 nights. Earth temperature about 2° and water 1·3° higher than last October. Relative humidity was 3·5% above the average. The amount of bright sunshine, 29¼ hours, is the least on record for October, representing only 5·7% of the time the sun was above the horizon. Rain fell on 20 days to the total of 3·618 in., bringing up the amount from the 1st January to 33·521 in. The direction and force of the wind was variable; on the 7th a moderate WSW. gale occurred from 3 a.m. till 2 p.m. Distant thunder heard on the 8th and 10th; slight hail on the same days; hoar frost on the 11th; and slight fogs on 9 days.

During the first week of November the barometer rose to the extent of 1·0 in., the atmosphere nearly at "saturation point" with humidity, causing dull weather with more or less drizzle every day. Thunder and lightning occurred to the West at 3-15 p.m. on the 1st, attended with slight rain and hail. The means for the week:—Barometer 29·873 in.; temperature 44·67°; humidity 93·5%; total rainfall 0·657 in.; sunshine 7 hours 55 minutes; wind Westerly. During the second week pressure was remarkably high, with slight range; atmosphere continued humid—on two days fully saturated; mean temperature, except on the 13th, when it was 37·5°, decidedly above the average. Means:—Barometer 30·391 in.; temperature 46·5°; humidity 95%; total rainfall 0·557 in.; sunshine 1 hour 45 minutes; wind Westerly or calm.

W. W. Midgley, F.R.Met.S.

Met. Observatory, Bolton, November 20, 1889.

◆◆◆◆◆◆◆◆◆◆◆◆

Sheffield.

Meteorological Summary.

October, 1889.	TEMPERATURE.							RAINFALL.				
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for Oct.* Daily Max.	Means for Oct.* Daily Min.	Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Oct.* Ins.
Sheffield ...	58°	17th	36°	15th	47°	—	—	3·95	23	0·71	7th	—
Spurn Head.	58°	2nd	41°	9th	49°	—	—	3·59	21	0·63	16th	—
York	58°	2nd	34°	11th	47°	55°	41°	4·12	23	0·57	11th	2·64
Barrow	57°	1st	38°	26th	48°	—	—	5·06	20	0·94	9th	—
Liverpool ...	56°	30th	38°	11th	48°	54°	45°	3·02	20	0·48	12th	3·62
Holyhead ...	58°	5th	40°	23rd	50°	54°	47°	5·13	25	1·13	3rd	4·53
Oxford	59°	16th	32°	14th	48°	55°	42°	2·44	18	0·53	27th	2·72
London	61°	16th	35°	13th	50°	57°	43°	3·82	24	0·71	19th	2·74

* The means of Temperature and Rainfall for October are for 15 years.

October 16 to November 15, 1889.

Pressure.

On October 16th pressure was low, ranging from 29·6 in. to 29·7 in., and it was 29·7 in. all over the country on the 17th, and had fallen still lower on the 18th. On the 19th the centre of a depression with readings down to 29·1 in. was crossing the country, but on the 20th the barometer was slowly rising, and continued to do so on the 21st, when it ranged between 29·2 in. and 29·6 in. It recovered further on the 22nd and 23rd, when the readings were between 29·6 in. and 29·9 in., being lowest in the South. On the 24th the barometer rose to 30·0 in. in all places, and to 30·2 on the 25th, keeping high on the 26th but giving way on the 27th, when it was down to 29·6 in. in the South and 30·2 in. in the North. It continued to fall on the 28th and was below 30·0 in., and on the 29th a depression from the North West caused a fall to 29·5 in. in that region, but the readings were up to 29·9 in. in the South. The fall continued in the North on the 30th, where the barometer was down to 29·2 in., but had not changed in the South, and on the 31st there was a gradual recovery of pressure. A deep depression with readings down to 29·0 in. was over the North Western parts of the kingdom on November 1st, but it passed away to the North on the 2nd, and pressure was recovering. On the 3rd it ranged between 29·5 in. in the North and 29·8 in. in the South, and on the 4th it was 29·7 in. in all places, but fell slightly in the North on the 5th, though slowly rising in the South. On the 6th it was rising decidedly in all places, being up to 30·0 in., and remained much the same on the 7th, continuing to rise on the 8th, when it ranged from 30·4 in. to 30·5 in. Pressure remained high and varied little up to the 15th.

The Weather.

During the week ending October 19th the weather was in a changeable, unsettled state, and heavy rain fell in many parts of the kingdom. Lightning was seen in the South of England on the night of the 16th. On the 19th the wind increased to a strong gale from the Eastward. Temperature was low at the beginning of the week, sharp frosts being experienced over the inland parts of Great Britain on the 13th, but afterwards the thermometer rose and was above the average. Rain fell on six days at Holyhead, five at Oxford, four at Sheffield, Spurn, York, Barrow, Liverpool, and London. From October 20th to 26th the weather underwent a considerable change. At the beginning of the week it was wet, thundery, and unsettled, but it improved slowly as the week advanced, and fine weather set in in the North and West, but slight rain continued in the East, and on the 24th slight falls of snow occurred on the North East coasts. Temperature was moderately high at first but fell during the week, and ground frosts occurred in some parts of England on the 24th and 25th. Rain fell on seven days at Sheffield and York, six at Spurn, five at Holyhead and London, four at Liverpool and Oxford, and three at Barrow. The following week, from October 27th to November 2nd, the weather again became very unsettled and heavy rain fell in many places, though interspersed with some fairly long intervals of sunshine, especially in the Eastern and Southern parts of the kingdom. The air on the whole was tolerably mild, temperature not differing much from the normal. Severe gales were experienced on all coasts on October 31st and November 1st, those on the West and South coasts blowing from the West, and those in the East and North blowing from the South and South East. Rain fell on seven days at London, six at Sheffield and Barrow, and five at Spurn, York, Liverpool, Holyhead, and Oxford. During the week from November 3rd to 9th the weather became of a much more settled character and very little rain fell, though the air was damp and misty or foggy in many places. Temperature at the beginning of the week was low, but it increased decidedly on the 7th, and maximum readings exceeding 60° occurred in several places, and the air continued mild till the end of the week. Rain fell on six days at Barrow, five at Holyhead, four at Liverpool, two at Oxford, and one at Sheffield, Spurn, York, and London. The quantity of rain was not large at any of these places. The weather of the week ending November 16th was generally mild and quiet, but a good deal of fog and mist prevailed, and heavy rain fell in the West on the 14th. The distribution of pressure was almost continuously anticyclonic, and temperature was high for the time of the year, reaching 60° at times. Sharp frosts were, however, experienced over England on the 12th, 13th, and 16th. Rain fell on six days at Barrow, five at Liverpool, four at Holyhead and York, two at Sheffield, Spurn, and London, and none at Oxford.

Sun Spots.

Owing to the Observatory being under repair no observations could be made from October 16th till November 7th. On the latter date the sun was free from spots. On the 8th there was a faint spot past the centre of the disc to the south of the equator, but this had disappeared on the 9th, and the sun was also spotless on the 10th, 11th, and 12th. After this date till the 15th clouds prevented any observations being made.

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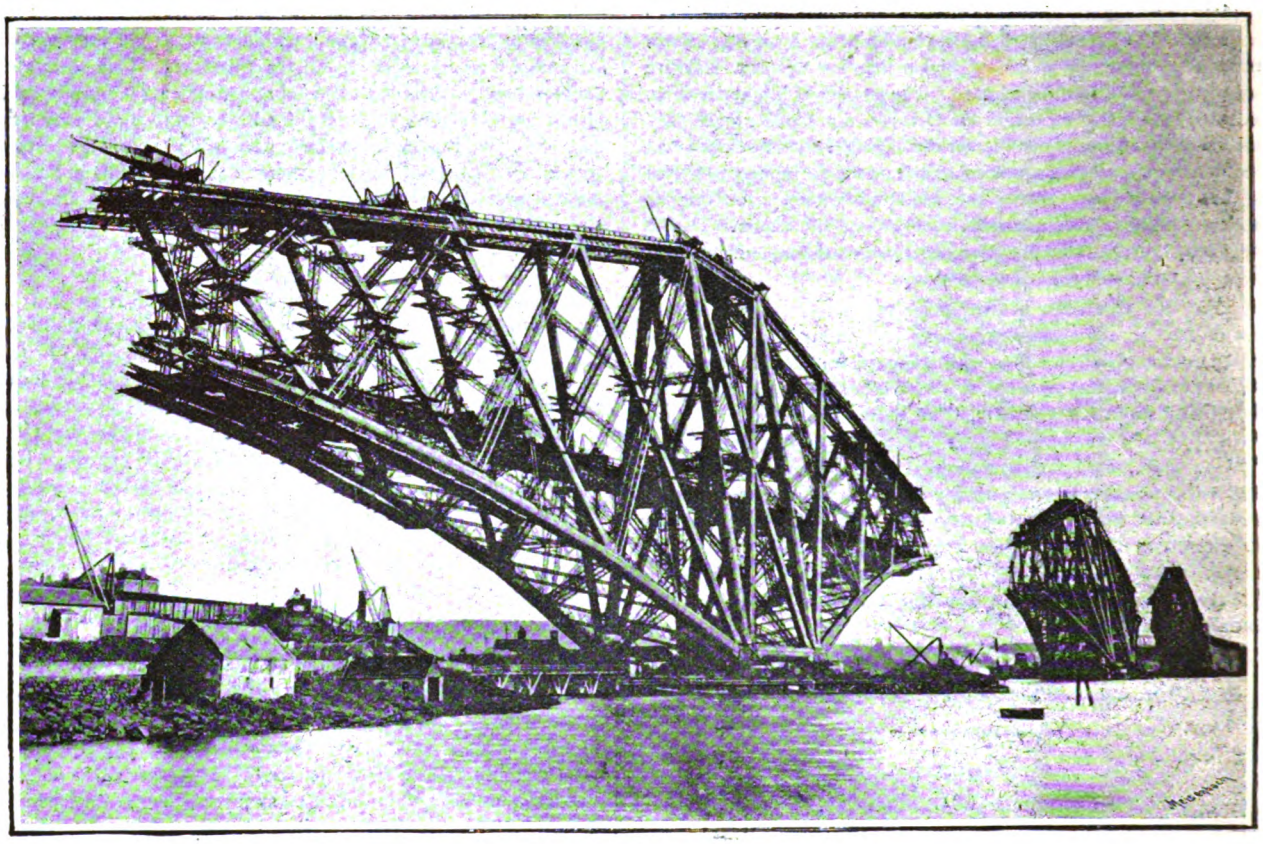

THE FORTH BRIDGE, NORTH.

From a Photograph by Valentine & Sons, Dundee.

The Forth Bridge.

BY M. TRELEAVEN READE.

THE art of bridge-building, although one of the oldest practised by the engineer, has made more rapid strides during the last fifty years than throughout the whole of its previous history. Although this may be largely attributed to the great advances recently made in mathematical and physical science, the enormous increase in span conspicuous in some modern bridges could never have been attained if wood and stone had not been superseded first of all by cast iron, then wrought iron, and finally, at the present moment, by steel.

Cast iron, although vastly superior in strength to either stone or wood, was soon found to be limited in its application to the construction of bridges. Its low tensile strength compared with its remarkable resistance to compression necessitated its being applied much in the same way as stone in a masonry bridge, but differing in being rigidly connected together, and not relying solely on stability due to weight assisted by the adhesion of mortar or cement. Great depth was therefore needed to obtain sufficient rise for the arch, and the centring and scaffolding requisite for support during construction in many cases formed a serious obstruction where a free passage underneath was necessary. These difficulties were surmounted by the introduction of wrought iron, which, owing to its high tensile strength, greatly facilitated an increase of span. This was realised in the construction of the Menai Suspension Bridge by Telford in 1826, which type of bridge has been unsurpassed for length of span, lightness, and elegance, where the great rigidity necessary in a railway bridge was not needed. Want of stiffness, and liability to change of form under a slight variation of load, has prevented its adoption for this purpose, except in modified forms, principally developed in America.

The next form of construction in which wrought iron has been used is the continuous tubular girder designed by Robert Stephenson to carry the Chester and Holyhead Railway over the Menai Straits, and known as the Britannia Tubular Bridge.

The "Giant Bridge," which now crosses the Firth of Forth at Queensferry in two clear spans of one-third of a mile each, may be described as being a further scientific development of this principle of a continuous girder, and its erection has been watched with the greatest interest by engineers in all parts of the world. The Firth of Forth, which here narrows to a width of about a mile and a half, has hitherto been a great obstruction to the development of the North British Railway. Its completion will be of the greatest utility in shortening the east coast route between London and the north of Scotland.

For the benefit of the untechnical reader it will be well, perhaps, to explain the forces acting in a continuous girder, which, as its name implies, is one extending as a rigid structure over three or more supports. The tendency under these conditions is for it to assume the form shown in the diagram (*fig.* 1) when under the action of its own weight, which will be further intensified by any additional loading. It will be observed that over the points of support the curve naturally taken by the girder will put its upper surface into a state of tension and its lower surface into compression, and that in the central portion of each span these conditions will be entirely reversed. The points at which these forces exchange places, or "change sign," in technical phraseology, will obviously be at the points where no bending occurs; these are known as the points of contrary flexure, and are represented by the points A, A, A, A, in *fig.* 1. There being, therefore, no tendency to

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bend at these points the girder might be hinged there and still retain its stability. This is the general principle of the Forth Bridge, but in this case the portions over the supports are combined with the supports, being constructed of mild steel in the form of tubes and lattice girders, rivetted together to form one rigid frame. The portions projecting out on either side in the form of brackets are designated "cantilevers," and bridges of this type are now always known as "cantilever bridges." The effect of these cantilevers is practically to reduce the span of the bridge by the length of the bracket at either end. The prodigious scale on which this bridge is built renders its own weight and the lateral pressure of the wind by far the most important stresses which it has to resist, the weight of a train being small in comparison. The predominance of the former of these stresses must necessarily have great influence on the design, as the lighter the form of bridge the less will be the scantling or sectional area of material necessary to ensure its stability.

FIG. 1.

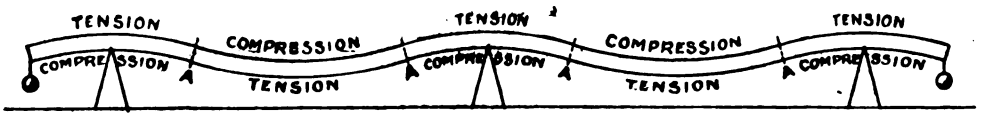


DIAGRAM SHOWING STRESSES AND DEFLECTION OF A CONTINUOUS GIRDER.

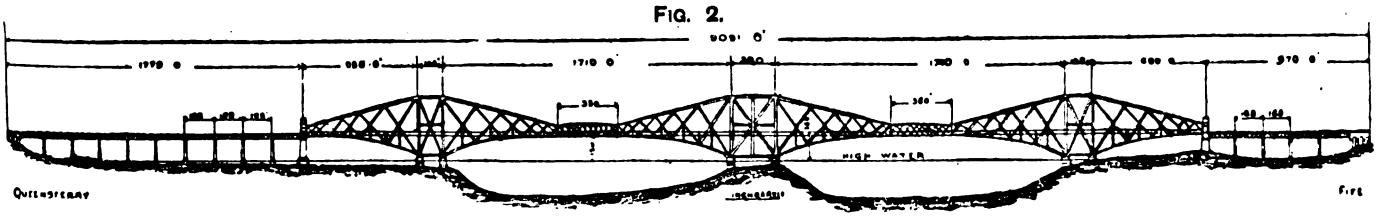
It is, therefore, evident that lightness of construction, apart from considerations of direct economy of material, had to be an essential feature in the design—a desideratum partly attained by the use of tubular struts. Also, owing to the exposed position of the site and the necessity of causing no obstruction to the channels, a method of construction requiring scaffolding or intermediate supports of any kind was out of the question. These conditions, coupled with the exceptional spans and masses of material involved, also precluded the adoption of the system followed in the Britannia Bridge of floating completed sections of the structure into position, and then raising them up to their ultimate level by means of "hydraulic jacks."

Although various other plans had at times been proposed for connecting the opposite shores of the Forth, to Sir John Fowler and Mr. Benjamin Baker, both eminent engineers, is due the credit of successfully coping with this gigantic undertaking, and their designs have been closely imitated in other though smaller bridges, which, having been completed first, have already demonstrated the merit of their ideas.

The main structure of the bridge consists of three pairs of cantilevers, each pair being supported by four circular stone piers, 70 feet in diameter at the base, and tapering upwards to 49 feet at the level of the coping, which is above high-water mark. Those supporting the middle cantilevers stand in the comparatively shallow water off the island of Inch Garvie, on either side of which are the two main channels of about equal width. These piers are in the form of a rectangle, 270 feet apart in the line of the bridge and 120 feet apart transversely. The Queensferry and Fife piers are similarly arranged, but are only 155 feet apart longitudinally. The greater spread given to the base of the Inch Garvie cantilevers it will be noticed, by reference to *fig.* 2, is owing to their being entirely self supporting, the others having additional assistance at their shore extremities by being bolted down to the large masses of masonry known as the "cantilever piers," which also form the terminal supports to the approach viaducts. These consist of steel lattice girders supported at intervals of 168 feet by masonry piers. They are continuous over two spans only, but some of them were temporarily connected whilst being raised, having been built as near the ground as possible, and the piers built up under them after each successive lift of the "hydraulic jacks." They were ultimately raised to about 150 feet above high-water mark. The reason for fixing the permanent way at such an altitude was the necessity of providing clear headway under the bridge for ships navigating the two main channels. The central girders of the two main spans rest at about the same level as those forming the approach viaducts, and serve to form the connecting links between the adjacent ends of the cantilevers, each one of which projects out a distance of 680 feet over the channel, leaving 350 feet to be bridged by the central girder. The linear contraction and expansion of a framework of steel of these dimensions due to changes of temperature in the weather is very considerable, and to provide for it the central girder is only rigidly attached to one cantilever, the other end merely receiving support, and is free to move horizontally in the line of the bridge. A good illustration of the effects of changes of temperature has just occurred in the completion of the continuity of the bridge by the final connections of the central girders at mid-span. An opportune moment had to be waited for when the temperature was such as to bring the bolt holes in the plates directly over one another.

In examining the construction of the bridge, what is first noticed is that the struts or members subjected only to compression are composed of enormous tubes built up of steel plates overlapping one another and rivetted together, while the braces or those members subjected only to tensile stresses are of an open or lattice girder type. The suitability of the tubular form for struts is owing to its rigidity or resistance to distortion being equal in every transverse direction, and largely exceeding that of a symmetrical solid form containing an equal weight of metal. This is an important necessity, as a member in compression being in a state of unstable equilibrium always has a tendency to bend, which it has to be capable of resisting. This is not the case with a member in tension, as the tendency then is towards straightness, and sufficient stiffness only is needed to enable it to carry its own weight. On this account and of the greater ease of construction the open form is more suitable for tension numbers, also offering as it does a freer passage to the wind. It will be readily conceived that an enormous amount of fitting has been necessary in this huge skeleton of steel, more especially at the junctions of the various parts, and great skill has been

FIG. 2.



THE FORTH BRIDGE—STRUCTURAL OUTLINE.

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shown by Mr. Arrol, the contractor for the bridge, in the adaption and invention of machinery to facilitate the accurate and expeditious attainment of this end. All the parts were accurately formed and bolted together temporarily in sections in the yard, the rivet holes being drilled by specially-constructed machinery. The sections were then taken to pieces ready for conveyance to the site, where they were permanently rivetted together in position by hydraulic rivetting machines, similar power being used to work the cranes used for handling the various parts. The cantilevers have been built out over the immense spans without intermediate supports of any description, the structure, so to speak, forming its own scaffolding. It might be thought this would be impracticable with the central portion, but such has been done, the girders being built out from either side temporarily as portions of the cantilevers, and when connected in the middle their rigid continuity with them broken.

The superstructure just described forms the most novel feature in the design, but the supports and substructure on which it had to be erected were no less important, and considerable skill has been displayed in getting firm foundations for the main piers in the bed of the Firth of Forth. These main piers, as mentioned previously, are 70 feet in diameter at the base, and taper upwards to 49 feet at the coping. Up to low water mark they consist of a solid mass of concrete; above this they are built of Arbroath stone set in cement and faced externally with granite, the top course in each pier being continued over the whole surface, and forming a seating for the steel bed plate, which is held down by 2½ in. steel bolts 24 feet long. Another bed plate forming part of the cantilever rests on this and is free to slide upon it horizontally, although at the same time held down to it by bolts.

It being necessary in the case of the Queensferry piers and two of those on Inch Garvie to put in the foundations at great depths below the surface of the water, in one case as much as 90 feet, what is known as the "pneumatic system" had to be adopted. The principle of this method is to exclude the water from an air-tight metal vessel or caisson resting on the bottom, by means of air pumped in under great pressure. This enables the excavation to be carried on by workmen inside, and the lower edge of the caisson being sharp it sinks down when partially undermined by the removal of material. When a good bottom was reached, the caisson, in this case an immense wrought iron cylinder, 70 feet in diameter, was filled with concrete and formed a base on which to build the stone piers already described. During the process of sinking, the air-tight portion of the caisson was lighted with the electric light, and, the clay bottom being hard, small hydraulic rams were fitted to some of the spades to force them in. The compressed air in the chamber was made use of to eject the excavated material through a vertical shaft constructed with valves for the purpose, another being provided to supply the concrete for filling the foundations of the caisson.

To give some idea of the vast scale on which this bridge is constructed, it may be mentioned that the upright tubes forming the central portion between each pair of cantilevers (see *fig.* 3) are twelve feet in diameter throughout, their total height being 360 feet above high-water mark. There are two spans 1710 feet each, and two 680 feet in the main structure, while in the approach viaducts there are eleven 168 feet, two of 179 feet, two of 173 feet, besides the arches forming the abutments. The main spans immensely exceed those of any bridge which now exists as a self-contained rigid structure; that is, one only transmitting the vertical pressure of its own weight to the supports, and not relying for stability on extraneous forces, as in the arch or the suspension bridge. Finality in size has, however, not yet been reached, a bridge having still larger spans being in contemplation in America, and recently preliminary designs have been prepared by Messrs. Schneider and Co., Creusot Ironworks, and H. Hersent for a bridge to cross the English Channel, for which Sir John Fowler and Mr. Benjamin Baker are consulting engineers.

It has only been by making judicious use of modern inventions and machinery that the building of the stupendous structure like the Forth Bridge has been brought within the range of possibility. The manufacture of steel has but recently been sufficiently perfected to render it reliable as well as economical for a work of this nature, and the substitution of machinery for manual labour has been found indispensable where such immense masses of material have had to be dealt with. It is the combination of mechanical inventions and materials unknown to early engineers as well as skilful design that has given us the Forth Bridge.

Provisional List of Geological Photographs,

Arranged according to Counties.

Compiled by OSMUND W. JEFFS, *(Secretary to the Committee on Geological Photographs).*

NOTE.—The following provisional list was drawn up for the use of the delegates at the Corresponding Societies' Committee, at the recent Newcastle meeting of the British Association. A committee has now been appointed to collect and register photographs of rock-sections, railway cuttings, localities illustrating denudation, coast-sections, and other features of geological interest in the United Kingdom. Societies and individuals interested are invited to co-operate in the work of this committee by sending photographic prints, lists of photographs taken in each county, and particulars of any sections, &c., desirable to be photographed, together with the names of those willing to assist. The committee consists of the following members: Prof. JAMES GEIKIE, F.R.S. (Chairman); Prof. T. G. BONNEY, F.R.S.; Prof. W. BOYD DAWKINS, F.R.S.; Mr. S. A. ADAMSON, F.G.S.; Mr. ARTHUR S. REID, B.A.; Mr. WILLIAM GRAY, M.R.I.A., and Mr. OSMUND W. JEFFS, Secretary, 12, Queen's Road, Rock Ferry, Cheshire, from whom all necessary information may be obtained:—

LIST No. I. (Part I.)

CHESHIRE.

Chester Society of Natural Science, per Geo. Frater, *3, Lorne Street, Chester.* (Views photographed by A. O. Walker, F.L.S.)

Cefn Bueno Caves, Vale of Clwyd ... ...
Do. do. (another view) ... ...
Cefn-y-bedd, near Wrexham ... ...
Holywell, Bagillt ... ... Sections in lower Coal Measures.

(Size 6 by 4 inches.)

Liverpool Geological Society, per W. Hewitt, *Secretary, Royal Institution, Liverpool.* (Photographed by E. Newall.)

Flaybrick Hill, Birkenhead, 1885 ... ... Fault in Keuper.
Do. do. 1885 ... ... Roche Montonnée.
Poulton Quarry, Wirral 1885 ... ... Jointing in Keuper.
Do. do. 1885 ... Joint, with horizontal slickensides.
Storeton Quarry, 1887 ... ... Showing "Footprint Bed."
Do 1887 ... ... Various views of the Quarries.
Wallasey, 1887 ... ... Keuper.
Wallasey, Church Road, 1887 ... Section in current-bedded Bunter.
Do. 1887 ... Do.
Prenton Lane, Birkenhead, 1887 ... ... Junction of Keuper and Bunter.
Bidston Hill, 1887 ... ... Keuper.
Flaybrick Hill, 1887... ... ... Keuper and Bunter.
Hilbre Island, 1887 ... ... Conglomerate bed.
West Kirby, 1837 ... ... Junction of Keuper and Bunter.
Thurstaston, 1887 ... ..." Thor's Stone"—an outlier of Bunter.
West Kirby, 1887 ... ... Fault at Calday Grange.

(Size 8½ by 6½ inches.)

CORNWALL.

Photographed by Percy F. Kendall, *31, Parkfield Street, Manchester.*

Land's End ... ... Columnar jointing.
St. Erth ... ... Pliocene clay.
Do. ... ... Contorted strata.
Do. ... ... Pliocene sand resting on elvan dyke.

ISLE OF MAN.

Photographed by Ed. Newall *(Liverpool Geological Society).*

Scarlett Point, Isle of Man... ... ...
Port St. Mary ... ... Massive limestone.
Do. ... ... Glaciated limestone surface.
Do. ... ... Boulder clay.

(And some others not designated).

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LANCASHIRE.

Photographed by E. Timmins, C.E., *Runcorn.*

Runcorn... Section of Frodsham Beds, in lane leading to Higher Runcorn.

Photographed by Ed. Ward, *249, Oxford Street, Manchester.*

Series of views of the "Oxford Road Boulder," now in the Quadrangle of Owens College, Manchester.

,, ,, ,, Manchester Ship Canal.

Photographed by Ed. Newall, *Liverpool Geological Society.*

Two views of the "Calderstones" (Stone Circle), near Woolton, Liverpool.

LEICESTERSHIRE.

Leicester Literary and Philosophical Society. Per James Plant, F.G.S., *West Terrace, Leicester. Photographed by* John Burton & Sons, *Leicester.*

Croft Hill, near Leicester, July, 1881, showing syenite, trias, and boulder clay.
Do. do. May, 1882 ... ...
Barrow-on-Soar, June, 1881 ... ... Arches in lias limestone.
Mount Sorrel, July, 1875 ... ... Hornblendic Granite.
Do. September, 1887 ... ... Do.
Aylestone, June, 1882 ... ... Section in boulder clay.
Do. do. ... Large erratic block of Mount Sorrel granite.
Humberstone, May, 1881 ... ... The "Holystone" Erratic.
Broombrigg, Charnwood Forest, July, 1875 ... ... Charnwood Slate.
Benscliffe, Do. do. ... ... Do.
"Hanging Stone," Do. August, 1881 ... ... Do.
Woodhouse Eaves, Do. June, 1881 ... ... Do.
Saffron Lane, Leicester, June, 1882 .. .. Boulder clay, &c.
Breakback Hill, Charnwood Forest, June, 1881
Keuper, lying upon Cambrian slates.
Ring Pit Quarry, Charnwood Forest, June, 1881
Showing concentric rings in slate.
Swithland, Charnwood Forest, June, 1881 ... ...Slates.
Stoney Stanton, June, 1881, Syenite (southerly extension of Charnwood Rocks).
(Size 12 by 10 inches.)

NOTTINGHAMSHIRE.

Per James Shipman, F.G.S., *8, Manning Grove, Nottingham.*

Nottingham Castle ... ...Pebble Beds.
Kimberley ... ... Permian resting on tilted Coal Measures.
"Hemlock Stone," Nottingham ... ...
Nottingham ... ... Faulted Keuper.
Blidworth ... Outliers of Keuper; supposed "Druidical" remains.
Beeston ... . Interglacial sand and river gravel.

Photographed by John Burton & Sons, *Market Street, Leicester.*

Nottingham, June 15th, 1882 Church Cemetery, caverns in pebble beds.
Do. ... Do. do.
Do. Castle Hill, section of Bunter, showing east.
Do. Do. do. showing west.
"Himlack" (or Hemlock) Stone, Nottingham ... ...
Do. Do. showing denudation

SHROPSHIRE.

Per W. W. Watts, F.G.S. *(Sidney College, Cambridge).*

Minsterley ... Unconformity, Ordovician, and Silurian, Hope Dingle.
Do. ... ... Crumpled Ordovician grits, Hope Rectory.
Hope (Fox Inn) ... ... Basin in Ordovician grits.
Do. ... ... Arch in do.
Do. ... ... Concretion in do.
Pontesbury, Nils Hill ... ... Stiper stones, quartzite.
Do. ... ... do.
Minsterley ... ...Lower Arenig grits.
Do. ... ... Upper Arenig grits (road from Bishop's Castle).
Whittery ... ... Lower Caradoc ash.
Wotherton (Barytes Mine) ... ... Fault in do.
Todleth Hill (E. side, near Lydham Heath and Church Stoke)
Columnar andesite.
Llanfawr (top of) ... ... Intrusive dolerite.
Corndon (S.E. of)
Dolerite resting on Arenig shales (base of Corndon laccolite).
Do. (S.W. of) ... Shales resting on dolerite (top of Corndon laccolite).
Do. (from W.) General view (on two continuous quarter-plates).
Cwmmawr, W. of Corndon .. .. Laccolite mass.
General view of Roundtain, from S.W. ... ... Do.
Do. from W. ... ... Do.
Much Wenlock ... Road through Wenlock Edge (Wenlock limestones).
Benthall Edge ... ...Limestone Quarries.
Wrekin (view of, from Benthall Edge) ... ...
Broseley... Bedding and jointing in carboniferous sandstone, Corbett's Dingle.

To be continued.

Societies and their Work.

THE reports of the proceedings of provincial scientific societies indicate not only that a large amount of really useful work is being actively carried on by their means, but also that the average standard of the communications read before them is being raised. It is not easy to over-estimate the benefits to the community of such societies, and a striking sign of the times is the steady multiplication of scientific societies in different parts of the kingdom. Whilst we desire to report as fully as we can the proceedings of local societies which are of general interest to workers in branches of knowledge in other localities than those specially interested, the continued increasing demands upon the space at our disposal preclude us from noticing all of these matters at such length as we would wish. We have now to briefly refer to the work of several societies which we were unable, through pressure of space and other reasons, to notice in another column.

The Yorkshire Geological and Polytechnic Society—one of the most active bodies of the kind in the North of England—has just held its annual meeting, and is in a satisfactory position. A sum of £5 has been presented to Mr. G. R. Vine for the prosecution of his original researches in fossil polyzoa. At this meeting an address was read by the president (the Marquis of Ripon), and papers by Mr. C. E. de Rance, on "Underground Water Supply and River-Floods;" by Mr. Thos. Tate, on "Yorkshire Petrology;" by Messrs. T. Hick and J. Cash, on "The Structure and Affinities of Lepidodendron;" and the Rev. E. Jones, on "Elbolton Cave, near Skipton," from which a number of bones of wild beasts and man (neolithic) were obtained in a good state of preservation.

The Leeds Naturalists' Club and Scientific Association have continued their series of demonstration-lectures on Taxidermy, given by Mr. E. B. Waite, which have been very successful. Firstly, the birds have been skilfully and deftly treated, and then one of the mammals, the rabbit, followed by a specimen of the *reptilia* in the common frog. At the weekly meetings of the Club interesting communications have been given on "Albino Birds," by Mr. J. B. Hall, and on "Marine Birds," by Mr. E. K. Waite. Mr. F. W. Branson, showed the members his small marine aquarium, and gave some lucid hints as to the methods of setting up and managing these delightful and, at the same time, necessary equipments to the naturalist's work-room. At another meeting the President, Professor De Burgh Birch, presented some experiments in recording the movement of the body, including respiration and pulsation.

At a recent meeting of the Leeds Conchological Society, Mr. G. Roberts described some varieties of *Helix hortensis* from Kent. Mr. W. Nelson gave an account of a conchological ramble in the Spofforth district, and one was also given on the molluscan fauna of Ireland. The exhibits shown were unusually valuable and rare, and were derived from all parts of the kingdom.

Practical meetings are the order of the day in many of our societies, as it is found that members who wish to work really learn more at such gatherings than at more formal meetings. On account of their success in the past, the Manchester Microscopical Society are arraning for a series of demonstrations covering the whole field of the manipulation of the microscope. The histological course for this season will be devoted to the examination of a typical flowering plant. The same society had a valuable paper recently read before them by Mr. W. Blackburn, F.R.M.S., on the "Organisms of Fermentation, Putrefraction, and Disease," in which the author sketched the history of microscopical research in connection with this subject from the time of Leenwenhoeck to Pasteur and Dallinger at the present day.

At the Liverpool Microscopical Society "Some Micro-Chemical Reactions and their Uses," was the subject of the paper read at

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the November meeting by Mr. A. Norman Tate, F.I.C., who referred to the great value of the microscope in geological and mineralogical inquiries, and described some of the most useful chemical reactions, showing the forms of numerous chemical salts produced under different conditions. At the *conversazione* that followed the paper there was a large display of microscopes, slides and other objects, many of which illustrated the subject of the paper.

Speaking on the subject of town gardens, before the Manchester Society of Field Naturalists, Mr. Leo H. Grindon gave some useful suggestions for the propagation of trees in the midst of towns. Amongst suitable trees he would introduce the tulip tree, mulberry, black poplar, elder, ash, lilac, maple, apple, walnut, and numerous shrubs and climbers, all of which would thrive if properly treated. In the same city the Cryptogamic Society still record the successful "finds" made in the course of the rambles of their members, Mr. J. Cast exhibiting at a recent meeting a number of rare European mosses, including one new species from Styria and Norway.

The Birkenhead Literary and Scientific Society are now devoting more attention to the scientific portion of their programme than formerly. At the November meeting, Professor Herdman read a paper on "The Structure and Life-History of an Ascidian."

A very practical paper was that given by Mr. Henry Adams, M.I.C.E., to the City of London College Science Society on "Apparatus Used in Weighing." The proceedings of this society continue to be of an animated and usefully varied character. A journal is published containing the principal papers read before the society.

The amateur photographers of Manchester have been also busy with the practical studies of their art. *Eikonogen*, as a developer, has been the subject of several trials, with considerable success.

The sixteenth session of the Leeds Geological Association opened on 17th Oct., when an extensive exhibition of specimens of fossils, minerals, and precious stones was arranged, the chief contributors to which were the president (Mr. J. E. Bedford), Prof. Green, F.R.S., Messrs. C. S. Bedford, W. H. Bedford, Godfrey Bingley, W. Cheetham, W. H. Gill, S. A. Adamson, C. D. Hardcastle, and J. H. Gray. A series of geological and other lantern views in the district of Grange-over-Sands was presented, followed by illustrations of the scenery of Yorkshire, the whole exhibition embracing 300 views. At the Manchester Geological Society, the president (Mr. Henry Hall) gave an address, in which he referred to the duration of our coal supply. He fixed the available coal supply existing at less depths than 4,000 feet at 90,207 millions of tons, which, at the prsent rate of increase in the consumption, would only last us 192 years from the present time.

The members of the Liverpool Geological Association were shown by Mr. T. S. Hunt beauties of Highland scenery, many of which have scientific interest, whilst their brothers of the craft, the Liverpool Geological Society, have been discussing the nature of those curious nodular concretions found in the magnesian limestone near Sunderland. Mr. Wm. Semmons also displayed for their consideration a series of exceptionally-fine crystals of topaz.

Mr. T. Mellard Reade gave the members of the Liverpool Architectural Society some excellent hints on the building qualities of sandstone, and illustrated by an original experiment the circulation of water in that rock.

Leaving the present for the past, the Lancashire and Cheshire Antiquarians had presented to them, by Mr. H. T. Crofton, a carefully-prepared paper on the early history of coal mining in Lancashire and Cheshire, in which much historical lore was included of an interesting character, and, on a subsequent occasion, heard Professor A. H. Sayce, of Oxford, discourse upon recent discoveries in Palestine. At Chester, the local antiquarians spent a profitable evening discussing the unique discovery of a Runic stone at Overchurch, recently chronicled in detail in our pages. The Disney Professor of Archæology (Rev. T. F. Browne) at Cambridge gave what was regarded as the most successful reading of the "runes," in the deciphering of which he had acknowledged the valuable aid received from Professor Stephens and the Rev. Wilfrid Dallow, whose paper in *Research* first called the attention of the public to the unique historical importance of this discovery in the Cheshire Wirral.

In an address to the Liverpool section of the Society of Chemical Industry, Dr. Hurter dealt with the effects of temperature and pressure on the work of condensation of aqueous hydrochloric acid. He clearly pointed out the theoretical considerations connected with the subject, and their bearing on practical work, and a discussion on his address will take place at the January meeting of the section.

Societies.

Archæology.

HISTORIC SOCIETY OF LANCASHIRE AND CHESHIRE.—At the first sessional meeting of this society, Mr. T. Harrison Myres, architect, F.R.I.B.A., read a paper on "Monumental Brasses," having special reference to those of Lancashire and Cheshire, illustrated by about 100 large and carefully-prepared diagrams of rubbings taken from the best examples in England. Mr. Myres stated that no branch of archæology was more interesting to the student or amateur than that which embraced the investigation and illustration of the sepulchral monuments of past ages, whether viewed as an evidence of costume or from the treasury of heraldic knowledge which they furnish. The monumental brass possesses a paramount degree of value and utility, helping to fix dates to ancient documents, illustrating the various periods of architecture, and throwing much light on the manners and dress of bygone days. After describing the composition of the sheets of brass anciently used, the lecturer said that the best of the existing examples of brasses were to be found in the Southern and Eastern counties, and that about 4,000 were still to be seen in England, though not less than 8,000 were stolen, lost, or destroyed during the period of the Commonwealth. The oldest existing brasses in England (rubbings of which, taken by the lecturer, were submitted) are those of Sir John D'Aubernon and his son, 1277 and 1327, from Surrey, both in a good state of preservation. Having distinguished between English and Flemish brasses, Mr. Myres proceeded to describe the brasses of Westminster, St. Alban's, and Waltham Abbeys, All Hallow's Church, Barking, London, those in the Isle of Wight, Sussex, Kent, Whalley, Preston, Winwick, Ormskirk, Sephton, Wilmslow, and Bebington, in Cheshire, giving the Latin inscription, with English translations, and concluded a most interesting paper by appealing for the perservation or careful restoration of such ancient relics, particularly by such a society as that before which he appeared.

CHESTER ARCHÆOLOGICAL SOCIETY.—At the introductory meeting of the session on October 29th, a paper, contributed by the Rev. G. F. Browne, Disney Professor of Archæology at Cambridge, was read by Archdeacon Barber, dealing with the recent discovery of a stone with runic ornamentation and inscription, the first of its kind found in Cheshire. Professor Browne gave the various interpretations of the runic characters and his latest translation. A full account of the stone has appeared in our columns from the pen of the Rev. W. Dallow, who first drew public attention to this unique relic of an ancient Saxon "bidding stone," probably dating from the 7th century.

Biology and Natural History.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—At the meeting on October 21st Mr. J. W. Lassetter exhibited specimens of *Atrypa reticularis* from the Silurian, showing various stages of

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growth. Mr. H. Hawkes mounted specimens of some of our rarer plants including *Sibthorpia Europæa*, *Neottia æstivalis*, *Silene acaulis*, *Dianthus cæsius*, *Lobelia urens*,, &c., and under the microscope stellate hairs of corolla of *Corea preciosa*.—On October 28th Mr. A. Camm exhibited the following fungi: *Hemiarcyria rubiformis*, *H. serpula*, and *Craterium aureum*. Mr. Thompson then read a paper, "Notes on the Crayfish," in which he described the life-history of this *crustaccan*, and illustrated his subject by a series of drawings and dissections.—The annual meeting was held on November 4th for election of officers, &c. The reports of the general secretary, secretary of committee, curator, and treasurer were presented, the latter showing a balance of £3 17s. 5d. in favour of the society. On the motion of Mr. T. H. Waller, B.A., B.Sc.. the retiring president, seconded and supported by Messrs. C. P. Neville and J. Edmonds, Professor Hillhouse, MA., was unanimously elected president for the ensuing year. Messrs. Deakin and Corbet were elected vice-presidents; Mr. J. Collins, general secretary; Mr. White, secretary of committee, and Mr. Madison, curator. The other officers were re-elected. The election of committee and vote of thanks to retiring officers brought the meeting to a close.—On November 11th Mr. H. Hawkes exhibited specimens of *Osmunda regalis*, *Ophioglossum vulgatum*, and *Botrichium lunaria*, our only native examples of exannulate ferns. Mr. P. T. Deakin then read a paper on "Notes on the Country Around Christchurch, Hants." The writer described the situation of the town, and referred to its history and antiquities. It was once a seaport, but the harbour has become silted up until no large vessel can enter it. The great charm of this district to the scientist is its geology, for it gives us an almost complete section from the Lower to the Upper Eocene in the space of a few miles. In the Bournemouth beds we find impressions of leaves and the remains of tree trunks, the latter bored through and through by a marine mollusc, of which, however, we could find no trace. Although some organic remains are to be found nearly all along the coast line, yet it is only when we come to Barton Cliff that they really abound. The writer gave lists of those commonly found and also of those less frequently met with. One part of the coast was particularly interesting, from the fact that the change from marine to fresh-water species was well seen. A description of the land, fresh-water and marine shells was also given. The paper was illustrated by collections of fossil and other shells.

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THE CLYDESDALE NATURALISTS' SOCIETY.—The first meeting of the seventh session was held on 25th September, Mr. D. Corse Glen, F.G.S., in the chair. Mr. George G. M'Kenzie exhibited specimens of the great reed mace, *Typha latifolia*, from Rossshire. This tall-growing marsh plant, which sometimes reaches a height of 10 to 12 feet, is rare in the West of Scotland, having disappeared from some of the localities where it was formerly known. In districts where it occurs abundantly the down from its heads is used to stuff mattresses and pillows, and its leaves are utilised by coopers to tighten the staves of casks. The pollen was at one time employed in the manufacture of fireworks, and the roots are said to have been eaten as salad. Mr. Alfred Brown read an interesting paper on "The Fishes of Loch Lomond," in which, after describing the physical characteristics of the loch, he reviewed in detail its fish fauna, comprising in all 19 species, as follows:—The river lamprey, sea lamprey, sharp-nosed eel, blunt-nosed eel, salmon, bull trout, sea trout, brown trout, powan, pike, tench, roach or braise, minnow, loach or beardie, flounder, three-spined stickleback, four-spined stickleback, ten-spined stickleback, and perch. In addition to these migh' possibly be included the great lake trout, introduced from Switzerland, and the river trout, introduced from America. The so-called *salmo ferox* is also said to exist in Loch Lomond, but the author is of opinion that no true example of this variety has ever been taken. Setting aside these doubtful and introduced forms, there are no less than 19 species which may be considered indigenous to the loch—a very remarkable number when we think of the very meagre fish fauna of most Scottish waters. The most notable absentee from this list is the char, a fish found in many of our Scottish lakes, principally those of an Alpine character, and which one would expect to find amongst the inhabitants of a deep, cold, clear loch such as that under consideration. It is, however, probable that the comparatively recent marine condition of Loch Lomond, and its palustrine, rather than Alpine, connection, may be a sufficient reason to account for the absence of the char. It may also be noted that the grayling, though abundant in the upper reaches of the Clyde, and said to have been taken as far down as Rutherglen Bridge, above Glasgow, has not yet, apparently, found its way to the waters of Loch Lomond. Mr. Robert H. Read read a paper entitled "Notes of an Ornithological Trip to Invernessshire last Easter." The writer said that he had been fortunate enough to observe many interesting examples of bird life. He found the Black-headed Gull, settling down to breed on a swamp, and in a thick fir tree close by came across the tawny Owl asleep. During a thirty-mile ramble over the mountains, with a keeper, he had an excellent chance of observing a Golden Eagle, which rose from the boughs of a bleached and lifeless pine tree, and sailed in graceful curves overhead without once flapping its wings, until it was lost to view behind the mountain tops. Amongst the snow he put up several Ptarmigan just assuming their grey mottled summer plumage, and, descending into a rocky glen, he saw the home of the Golden Eagle among the precipitous and inaccessible cliffs which bounded it. Here he saw several Stags, some just after shedding their horns, of which he found several on the ground partially gnawed away. From this habit of the Red Deer, cast antlers are seldom to be found unless immediately after they are shed. Mr. Read also had the pleasure of observing the Osprey or Fishing Eagle, and its nest, at the well-known protected breeding place on the ruined castle rising from the waters of Loch an-Eilan. The male bird usually arrives on April 1, and the female a few days later. This year the male arrived true to his time, but at the date of the writer's visit (April 20) no female had yet appeared, and afterwards Mr. Read heard that the Eagle himself disappeared from the locality. Along the shingly banks of the loch were found the Oyster Catcher or "Sea Pyat" exceedingly plentiful, their shrill cries being heard all day and well on into the night. He was surprised to find at such an early season a nest containing three handsome eggs. From this locality the familiar House Sparrow was entirely absent, but other small birds, such as Marsh Tits, Blue Tits, Finches, and Buntings were abundant, as were also Wild Duck, the Red-Breasted Merganser or Norway Duck, the Woodcock, and various Hawks. Mr. Read also discovered nests of the Grey Wagtail, Dipper, &c., and on the third day, after a ceaseless search, the rare nest of the Crossbill, with young.

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MANCHESTER SCIENTIFIC STUDENTS' ASSOCIATION.—At the opening meeting of the autumn session Mr. W. E. Hoyle, M.A., keeper of the Owens College Museum, lectured upon "Mutual Benefit Associations in the Animal World." He referred to various animals which formed themselves into partnership, each making some contribution to the well-being of the community. On the prairies of North America the burrow of the prairie-dog usually harbours another tenant, an owl, with whom the dog lives in perfect harmony. The rattlesnake often lives in company with the horned frog, and the shark in his peregrinations is frequently accompanied by a few agile little fish, who are said to aid in the finding of the necessary dinner for their lord and master. Many other instances might be adduced from different parts of the world and in various classes of the animal kingdom, but for one of the best we need go no farther than the shallow waters which encompass our island. Almost everyone must be familiar with the hermit crab, which protects its soft tail by means of the cast-off shell of some mollusc. A particular

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species of this crab, which he had often dredged in the Firth of Clyde, always has its protecting shell covered by a particular kind of sea anemone. Both are always found together, and it is easy to see how the benefit accrues to each partner. The tentacles of the anemone are provided with stinging cells, which serve to keep off unwelcome strangers. The crab possesses legs, which the other does not, and thus is able to carry his benefactor from place to place, and in that way increase his food supply. A most remarkable fact is that when the crab grows too large for his shell and has to seek for fresh quarters, he removes the anemone fom the old to the new abode. There is another animal which shares in his assemblage; a small worm lives coiled up just within the mouth of the shell, but, as he is merely there for what he can get, and contributes nothing for the benefit of the community, he must be regarded as a sleeping partner in the concern.

LIVERPOOL BIOLOGICAL SOCIETY.—At the meeting of this society held on Friday evening, November 8th, at University College, a collection of land shells of the Hawaiian Islands was exhibited, and formed an interesting feature of the proceedings. Professor Miall, of Leeds, afterwards gave an account of his recent investigations into the structure and life-history of some flies of the genus *chironomous*, illustrated by lantern slides and living specimens. Professor Miall treated his subject in the most masterly manner, and was frequently applauded.

Geography.

MANCHESTER GEOGRAPHICAL SOCIETY.—The annual meeting was held in the library, the Rev. S. A. Steinthal presiding. Mr. Eli Sowerbutts, the secretary, read the annual report, in which the council stated that the work of the society had been carried on during the year with a fair amount of success. Keeping in view the objects of the society to further the pursuit of the science by the study of documents, by communicating with learned societies and correspondence, and to encourage the right teaching of geography in colleges and schools, the council have been able to place before the members a valuable series of addresses on the various scientific, economical, and commercial aspects of the subject. Whilst they were gratified with the steady accession of members, it was to be hoped that, as the society became better known and its work appreciated, a large accession of commercial and philanthropic persons would be made in the roll of membership.

Geology.

GEOLOGICAL SOCIETY OF LONDON.—The first meeting of the winter session was held on 6th November, Dr. Blandford in the chair. The following communications were read:—"On the Dinosaurs of the Weald and the Sauropterygians of the Purbeck and Oxford Clay," by R. Lydekker, B.A., in which he described some vertebrate remains from the Wadhurst Clay, and an imperfect skeleton of a large pliosaur from the Oxford Clay, in the collection of Mr. Leeds. Another palæontological paper was read by Professor T. Rupert Jones, on "Some Palæozoic Ostracoda," in which he described some new species and other specimens from North America, Wales, and Ireland. Mr. J. C. B. Hendy contributed "Notes on a 'dumb-fault' or 'wash-out,' found in the Pleasley and Teversall Collieries, Derbyshire." A double thickness of coal seam was worked in this colliery until the "wash-out" was reached, when both coal and shaly roof were replaced by sandstone.

GEOLOGICAL SOCIETY OF GLASGOW.—The second meeting of the 32nd session (being the annual general business meeting) was held on Thursday evening, 14th November, in the society's rooms, 207, Bath-street, Mr. Joseph Sommerville, vice-president, in the chair. The customary annual reports on the business of the past year were submitted by the secretary, treasurer, and librarian, showing the condition of the society to be satisfactory, and a cordial vote of thanks was passed to these gentlemen for their disinterested work. To fill the vacancies occurring at this time the following gentlemen were elected:—As vice-president, Mr. John Young, F.G.S.; as members of council, Messrs. James Anderson, Charles G. Bone, C.E.; Daniel M'Millan, and David Ross, LL.D. Mr. Robert Woodburn Gillan, Indian Civil Service, was elected, and several gentlemen were proposed as ordinary and life members. Mr. John Howat exhibited a number of specimens he had recently obtained from the Triassic beds at Forth River, Belfast, including Variegated Marls and Fibrous Gypsum, making some remarks upon their occurrence. Mr. James Thomson, F.G.S., exhibited a specimen, lent by Mr. James Miller, Canning-street, Calton, of a fossil fish, *Glyptolepus septopterus* of Agassiz, in a fine state of preservation. Mr. John Wight, C.A., exhibited a specimen of Diatomaceous Earth from Skye, used in the manufacture of dynamite. Mr. John Young, F.G.S., exhibited a well-preserved cranial bone of a Carboniferous Labrinthodont, which he had recently found embedded in the Lower Limestone shale at Braehead Quarry, near Busby, five miles from Glasgow. This bone seems to have formed one of the zygomatic or jugal bones of the skull of an amphibian reptile, seven or eight feet in length, as shown by comparison with other skulls of the same group in Britain. Its upper or exposed outer surface is ornamented with grooved and pitted markings similar to those seen on the skull of the genus *Pteroplax*, teeth of which are recorded as having been found in this locality. Mr. Young remarked that these lowly-organised amphibian reptiles are amongst the oldest of their class yet discovered, some five genera and seven species being noted from the Carboniferous strata of Western Scotland. They seem to have formed an intermediate link between the fishes and the true reptiles, having characters possessed by both groups. Their remains, which are very rare, are chiefly found in fresh-water or lacustrine strata, as they lived generally under aquatic conditions, although their footprints have been occasionally found impressed in the mud which formed the lake shores of the period. The locality now mentioned, near Busby, is the lowest horizon in which amphibian remains have yet been met with in the Glasgow coalfield. Mr. Dugald Bell read, on behalf of Mr. John Smith, Kilwinning, an interesting paper on "The Occurrence of Footprints in the Calciferous Sandstone between West Kilbride and Fairlies, Ayrshire."

Engineering.

LIVERPOOL ENGINEERING SOCIETY.—Mr. Henry H. West M. Inst. C.E., M Inst N.A., &c., the newly-elected president of the society, in his inaugural address at the Royal Institution, Colquitt-street, dealt with the progress of shipbuilding and engineering. After thanking the society for the honour they had done him in electing him to the presidential chair, he urged upon the members to promote by all means in their power the study and practice of engineering, and then proceeded to consider the progress which had been made in naval architecture from the earliest times up to the present day. The first types of floating vessels of which they had any record were the canoe, hewn from a single tree trunk, and the coracle, with a frame of osier twigs, covered and made water-tight by an outer skin laced to the basket-work foundation. As the former was limited in size by the dimensions of available trees, it was naturally doomed to extinction, but the coracle of the Ancient Briton had in it the same prineiple of construction as the Atlantic greyhound of the 19th century. In each there was a transverse and longtitudinal framing so interlaced as materially to assist each other in retaining the vessel's form, and covered with an outer envelope, fulfilling the double duty of keeping out the water and binding up the whole into a rigid structure. They must admit, however, that the single tree canoe was, as regards outline, a more graceful work of art than the short, broad coracle, and he was afraid they had made very little progress in the direction of excellence of form. If they compared the

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lines of the old Viking galley which had been recently unearthed with those of modern vessels, or vessels of any period, they could not but be struck by the fact that the ancient Norse shipbuilder had as true an intuition of symmetry and due proportion as any of his successors in the art. In one respect the old Viking ship had a distinct advantage over larger and more modern wooden vessels, and that was in the outer planks being made to overlap one another at their edges in clinker fashion, the edges being substantially rivetted together and further secured to the frame, giving her a strength and rigidity which could not be attained in the modern style of planking, and the absence of which sounded the death-knell of the wooden walls of old England. Naturally, when iron was first used for shipbuilding, the size and proportions of iron vessels remained pretty nearly the same as those then current for wooden ships, and the superior strength of the vessels, and their large cargo-carrying ability owing to their relative lightness, led to the rapid adoption of the new material. But these moderate proportions were not to rule for long. British shipowners soon found out that the larger the middle body of the ship could be made the more profitable she would be; so that existing iron ships were lengthened, and new ones came gradually to be built of proportions very different from those in vogue when the earliest iron vessels earned their reputation for great strength. To avoid the terrible disaster of capsizing at sea, designers had sometimes erred on the side of excessive stability, and when such a ship met with heavy weather at sea she would be uneasy and labour-some, with the result that the racking and straining of the structure would be most severe. He thought that occasional experimental tests of the position of the centre of gravity by inclining the ship after loading, and subsequently collating the results with the ship's behaviour at sea, would yield to the owner both interesting and profitable information. Much might be done in the future to reduce weight by arranging what he might call the incidental features of the ship that any one element of the structure should fulfil several functions, and thus lend either local or general strength to the whole, with a minimum of material. A difficulty in carrying out such a scheme lay in the fact that classification in Lloyds' register was a commercial necessity for most merchant vessels, and that Lloyds' rules lay down specific sizes for the various parts of vessels, which must in the main be adhered to, irrespective of strength given to the vessel in other ways. Regarding the weight of the propelling machinery, he ventured to think that if any material reduction were to be made in the near future in that of merchant steamers, it must be mainly by the use of forced draught, thus closely approximating to the practice of locomotive engineers. The engine-power, however, in ordinary cargo steamers was so moderate, and the weight of the machinery formed so small a proportion of the gross load displacement, that the naval architect (in which term he included the marine engineer) had addressed his attention to reducing the ratio between fuel used and cargo carried, economy of fuel not only effecting a saving of the cost of the coal itself and of loading it into the bunkers, but also releasing space and displacement to be used by freight-paying cargo. The consumption of coal per indicated horse-power was in 1850 to 1855 nearly three times what it is now, and that reduction had rendered it possible to employ steamers on voyages which could not have been attempted by steam 35 years ago. Those changes and economies had been brought about mainly by the studies and researches of the scientific engineers, and experiences and investigation had enabled them to make most substantial savings, not only in the quantity of fuel used in the manufacture of power, but also in the application of that power. Turning to improvements in the forms of ships, he considered at some length Dr. Kirk's block model analysis and the experiments and investigations of Mr. Feronde, which had resulted in establishing with very approximate accuracy the nature of the resistance which a vessel offered to be driven through the water. It was found that at low speeds the resistance consisted almost entirely of skin friction, and that the wave motion set up in the surrounding water was practically immaterial; so that within certain limits the influence of ship's form was practically powerless to increase her resistance. When that idea was mastered, a new class of steamers sprang rapidly into existence. They were built of steel, thus being light in themselves; they had triple-expansion engines, which reduced their fuel load; they were of large dimensions, and therefore relatively easily propelled; and they were of full form, in virtue of which they were proportionately large carriers without unduly increasing their resistance at the speed for which they were intended. In olden times ships were only used for carrying precious goods and luxuries, of which large values would lie in small compass; and therefore ships of moderate capacity were sufficient. But now they carried the daily food, fuel, and clothing for millions of people, and the materials for every manufacture in the world. The mere accumulation of the dry facts of experience did little by itself to further the progress of either science or art. It was not until accurate observations of practical fact was welded to careful study and analysis of those facts by the light of natural laws that the full riches of experience could be developed or its valuable lessons applied to new problems.——At the meeting held on November 27th a discussion took place on a paper by Mr. George Farren, entitled "The Stability of Earthwork and Masonry Dams." The vice-president, Mr. F. Huddleston, occupied the chair. The discussion bore to a great extent upon the relative merits of gravity dams and circular or arch dams. The discussion was opened by Mr. John Price, and he was followed by Mr. C. H. Darbyshire, who read a long letter from America on the subject of the well-known American dam, the Bear Valley Dam. Mr. R. E. Johnstone, Birkenhead, referred to the Vyrnwy Dam, and said that he thought there could be no doubt as to the stability of that structure, the masonry having been put together in the best possible manner. He would venture to say, however, that the Vyrnwy Dam was a rather costly construction; in his opinion, material might have been saved and yet left it sufficiently strong. Mr. Turner, hon. secretary of the society, also joined in the discussion.—Mr. Farren then replied at some length, answering all the various points that had been raised.—A hearty vote of thanks to Mr. Farren for his excellent paper closed the proceedings.

Reviews.

The Middle Lias of Northampton. By Beeby Thompson, F.G.S.

[London: Simpkin, Marshall & Co., 1889.]

THE publication of this work, which is largely a reprint from the *Midland Naturalist*, resulted from a suggestion offered by the author for an improved scheme of water supply for the town of Northampton. This scheme was not carried out, but so much information of a new and eminently useful character was obtained bearing upon the geology of the district that the author wisely determined to publish the results of his extensive and arduous investigations. The volume as it now stands comprises a full account of the Northamptonshire Lias from the points of view of stratigraphy, palæontology, and economy, considered also as a source of water supply and as a mitigator of floods. On all these aspects Mr. Thompson writes practically and convincingly, and shows an evident knowledge of the intricate details of this geological formation as can only be obtained from long and careful work in the field. Some of the most important sections in the county are fully described and complete lists of fossils given, besides which the author expresses his conclusions on the physiography of the period of which he treats. Perhaps the most valuable portions of the work are those relating to the economical uses of materials derived from the Lias, the building stones, clays, iron-stone, and lime, and the relations of the beds to the water supply. No social question is of greater importance to a community than that of the supply of pure water to large towns, and the inhabitants of Northampton should be indebted to Mr. Thompson for placing before

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them in so clear a light the nature of the problems upon which a satisfactory solution of the question of water supply depends. Briefly stated, Mr. Thompson's scheme for an improved water supply to Northampton is based upon the observation that in most of the surrounding valleys a great amount of water is accumulated several times a year by periodical floods. Many of the fields seem almost constantly under water in winter time, owing to the fact that they are lower than the water in the river when it is high, and they have nowhere to drain into. The equilibrium may be restored by putting into the porous beds of a district much of the water which is now naturally and artificially kept out of them, together with any additional surplus water that may be available. Mr. Thompson advocates the construction of artificial wells ("dumb wells"), about 100 feet in depth on the average, to enable this water to run away into the porous beds of the Middle Lias, where it is so much needed. These wells would be situated in all the valleys, and would extend through the alluvium and river gravels, and through the Upper and Middle Lias. Particulars of their construction are given in the work, besides which the questions of the probable quantity of water thus obtained, and the cost of the scheme, are all carefully considered. No reservoir or pipes would be required, the chief item of expense being the construction of the "dumb wells." It is well known that natural "swallow-holes" in isolated basins frequently materially and beneficially affect the water supply of the region in which they occur. There seems every probability that their artificial construction would, in the instance now given, also prove advantageous. The underground passage of water in the strata is as yet little understood. A committee is at work upon the subject, and has already accumulated valuable results affecting the water economy of the country. We trust Mr. Thompson may not be discouraged by the refusal of the local authorities to entertain his scheme, but continue his experimental researches into a matter of such obvious importance to the entire community. O. W. J.

The Optical Magic Lantern Journal has reached its sixth number in its November issue. The magazine continues to improve and is full of information, which will be of service to the amateur photographer and to the numerous persons who are interested in the lantern [surely the term "magic" might now be discarded] as an educational appliance of the highest order.

The Naturalist (Leeds) for October contains the concluding portion of the report of the Yorkshire Naturalists' Union excursion in Upper Teesdale; the report of the Yorkshire Boulder Committee; a paper on the "Two-barred Crossbill," by the Rev. H. H. Slater, M.A., and a variety of notes on ornithology, botany, mollusca, lepidoptera, &c.

Yn Lioar Manninagh (Ramsey: J. Craine).—The third number of the quarterly journal of the Isle of Man Natural History and Antiquarian Society is to hand. Amongst the varied contents we note several reports and notes forming part of the back transactions of the society for 1885; the proceedings of the meetings in April and May of this year; a report on "Place Names," by the Rev. S. W. Harrison; "Some Additional Notes on the Ballakaighen Canoe," by P. M. C. Kermode; "Sun Dials in the Isle of Man," by Miss A. M. Crellin, and other papers of interest. Professor Herdman contributes some notes on the marine invertebrate fauna of the southern end of the Isle of Man.

The Vertebrate Animals of Leicestershire and Rutland. By Montague Browne, F.Z.S. [Birmingham: Midland Educational Co., Ltd. 1889.]

THIS elegantly-printed quarto volume has been compiled by the energetic curator of the Town Museum at Leicester, who is also the author of a treatise on *Practical Taxidermy*, and other works. In its present form it is probably the most complete catalogue which has yet been attempted of the veretebrate fauna of the two counties of Leicester and Rutland, a district of England rich in features of interest to the naturalist, and especially to the student of ornithology. The earliest attempts to record the birds of Leicestershire were those of Churchill Babington, published in Potter's *History of Charnwood Forest*, and James Harley, in 1840. Since then numerous lists, more or less imperfect, have appeared in various scientific publications. In the preparation of the present work Mr. Browne, in addition to a good store of material to work upon, has had the good fortune to obtain possession of the original MSS. of the late James Harley, and has, besides, enriched his book with the results of many valuable observations of his own during an extended residence in Leicestershire. It must not be imagined that the work is a mere catalogue. Whilst the arrangement of the species is upon a principle well understood, proceeding from higher to lower forms, each species is accompanied by descriptive matter, often extending to the length of a short essay, and giving full particulars respecting the animal and its history. The list is not confined to living species; the records of palæontology have been searched to add to the available amount of information, and many forms, both living and extinct, are named and described which have not previously been recorded for the counties, the most notable of these being numerous birds, fossil mammalia, and a fine fossil fish new to science. A list is printed as an appendix, showing the dates of arrival of summer migrants in Leicester. An excellent map serves as a frontispiece, and the work is further embellished by several lithographed plates, copied, we believe, with one exception, from Dresser's *History of the Birds of Europe*. That exception is a plate representing Natterer's bat in characteristic attitudes, which is drawn by the author. The work will be invaluable to local students, and of great use also for reference by naturalists in other parts of the kingdom. O. W. J.

New and Forthcoming Works on Science.

AMONGST recent works on science we note that Mr. J. Logan Lobley has brought out his long-promised work on *Mount Vesuvius*, illustrated with maps and numerous plates. [London: Roper and Drowley.]—Messrs. J. and A. Churchill announce volume 1 of a work on *Chemical Technology, or Chemistry in its Application to Arts and Manufactures*, edited by C. E. Groves, F.R.S., and William Thorp, B.Sc., founded on that written by Richardson and Ronalds. The first volume deals with Fuel and its Application, and is written by Dr. E. J. Mills and F. J. Rowan, C.E., the information being brought well up to date.—Messrs. Longmans, Green & Co. announce the following:—*An Account of the Recent Expedition across Greenland*, by Dr. F. Nansen; *Electrical Engineering for Electric Light Students and Artisans*, by W. Slingo and A. Brooker.—The first volume of the new Contemporary Science Series [London: Walter Scott] has made its appearance, and is entitled *The Evolution of Sex*, by Professor Geddes and J. Arthur Thomson.—Messrs. Trubner & Co. announce a new work by Professor Angelo Heilprin on *The Bermuda Islands*, being a contribution to the physical history and zoology of the Somers Archipelago, with an examination of the structure of coral reefs.—Mr. Jas. Backhouse, Junr., is engaged upon a handbook of European birds for the use of field naturalists and collectors, with descriptions of the plumages and notes upon habits and distribution.

Publications Received.

The Vertebrate Animals of Leicestershire and Rutland, by Montague Browne (Midland Educational Co., Leicester and Birmingham); *Elementary Physics*, by Mark R. Wright (Longmans, Green & Co.); *The Butterfly, its Life History and Attributes*, by John Stuttard (T. Fisher Unwin); *The Half of the Hydrogen Atom Regarded as a Primordial or Formative Element*, by Dr. Isaac Ashe (paper read at the meeting of the British Association); Association of Public Sanitary Inspectors—*The Duties and Difficulties of Sanitary Inspectors*, by Dr. A. Newsholme, and *The Chemistry of Sewer Gas and its Relation to Disease*, by G. H. Wilkinson; *The Yorkshire Boulder Committee and its Third Year's Work*, by S. A. Adamson, F.G.S.; *Annual Report of the Severn Valley Naturalists' Field Club, 1888-89; Journal of the City of London College Society*; *Naturalists' Gazette*; *Life Lore*; *Knowledge*; *Naturalist*; *Assure*; *Selbourne Magazine*; *Johns Hopkins University Circulars*; *Literary World*; *Brewers' Journal*, *Wesley Naturalist*.

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NOTICES.

Several Reviews, Reports of Meetings of Societies, and other communications unavoidably stand over for want of space.

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Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the followlng numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

The Luminosity of Plants.

BY THEODORE W. DICKER.

CONSIDERABLE doubt characterizes many of the statements made with regard to this phenomenon. Generally, luminosity in plants manifests itself in two ways: in the emission of flashes of light from certain highly-coloured flowers, such as the Nasturtium; and in the development of a steady phosphorescent glow, as observed in certain fungi, such as the Olive Agaric. As the observations made regarding the former are of a somewhat unsatisfactory nature, it will be well to consider first the phenomenon as witnessed in fungi, in connection with which some well-authenticated facts have been observed and some careful experiments performed.

As observed in this division of the vegetable kingdom, it takes the form of a regular, spontaneous emission of light, varying in intensity, but generally of a pale-blue tint, which the term phosphorescence well describes, as it greatly resembles the light given off by animals and by decaying substances. It should be mentioned, however, that phosphorescence, as observed in the vegetable kingdom, is neither so frequent in occurrence nor so well ascertained in its nature as it is in the animal world.

Luminosity in fungi has been longest known in the mycelium—the merely vegetative and often hidden part of a fungus—of *Agaricus melleus*, or the "tree-killing" Agaric, a plant often found growing on the stumps of trees. But it is in *Agaricus olearius*, a rich yellow fungus, growing plentifully at the base of olive trees in Provence during October and November, that the phenomenon has received the most careful study, from the time of De Candolle downwards. As an instance of how much cautious investigation is necessary before an authoritative opinion upon any natural phenomenon can be formed, it may be mentioned that this able botanist held that luminosity in this plant was observable only at the time of its decomposition, whereas, both Tulasne and Fabre, who observed the phenomenon more carefully and at a later date, maintain that the property ceases at that period. Again, Fries ascribed to *Cladosporium umbrinum*, a mould parasitic on this Agaric, the production of the light. But the experiments of Tulasne, who scraped and cut the Agaric in various parts without noting any diminution of its luminosity, dispose of this hypothesis of Fries. In 1855 Fabre, in a series of interesting experiments, very carefully studied the phosphorescence of *Agaricus olearius*. He found the light to be steady, white and homogeneous, resembling that of phosphorus dissolved in oil. He was the first to show that the luminosity of this fungus was present also during the day. According to his observations, the gills, or spore-bearing surfaces, only were luminous. His experiments, however, were made at a low temperature, viz., in November, from 10° to 12° C., but Tulasne, who observed the plant at a higher temperature, found that the stem also was luminous in various places, both inside and out.

The luminosity is present only during vegetation, and passes with the life of the plant. It is not affected by sunlight, rain, or heavy, watery vapour. A decline of temperature below 3° C. causes it to disappear, but it returns with the return of a higher temperature, being most intense from 8° to 10° C. At 50° C. it is completely lost through the death of the fungus. Further and similar experiments lend weight

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to Fabre's conclusion that respiration—a process in plants mainly analagous to that which takes place in animals—is the cause of luminosity. The immersion o a phosphorescent fungus in water containing air has no effect upon its luminosity, but the substitution of boiled water causes it to disappear at once—an effect that is most likely due to the absence of oxygen. It re-appears, however, when brought back to the air. In a vacuum, in hydrogen and in carbonic acid it is immediately extinguished, but returns after remaining some hours upon restoration of the fungus to the air. When subjected to carbonic acid for a very long period the light never regains its original intensity. Immersion in oxygen causes no increase of light, but a decrease after 36 hours. Fabre's most important discovery was that *Agaricus olearius* when phosphorescent evolved more carbonic acid than when not so. In pure oxygen at 12° C. the pileus, or cup, with its gills yielded in 36 hours 4·41 C. cm. of carbonic acid for each gram of its weight, whilst a gram of non-phosphorescent substance gave off only 2·88 C. cm. of carbonic acid. A piece which had been deprived of its luminosity by subjecting it to a low temperature was treated in the same way, and gave about the same result as the non-phosphorescent substance. All these experiments show that when the luminosity was greatest the respiratory process of evolution of carbonic acid was at its highest. It is well known to botanists that certain flowering plants, particularly Cucurbita and some of the Aroideæ, give off heat to a marked degree at the time of producing their blossoms—a result due to the taking up of large quantities of oxygen for respiratory purposes; and, according to Fabre, the phosphoresence of fungi is due to the same cause. It has, however, been aptly pointed out that, as luminosity is almost confined to fungi, special means must exist in this group of plants for its production.

Valuable as are Fabre's experiments and the conclusions he draws therefrom, the specific cause of this luminosity has never been satisfactorily demonstrated. Among German botanists it is commonly attributed to a special substance, generally mucilaginous in nature. But this, Tulasne says, was absent from the luminous specimens of *Agaricus olearius* and of *Rhizomorpha subterranea* which he examined.

As contributing to this question of cause, the Rev. M. J. Berkeley, writing to the *Gardeners' Chronicle* for 1872 (p. 1258), gives the following interesting details. Some friends of his noticed one night on a log of larch or spruce "a blaze of white light which was perfectly surprising," and which, on examination, was found to proceed from a "white byssoid mycelium," which coated the inside of the bark. The luminous matter when enveloped in "five folds of paper penetrated through all the folds on either side as brightly as if the specimen was exposed." Unfortunately, it was not until the third day that the writer saw this luminous substance, and though it was possible even then to read the time on the face of a watch by it, the luminosity had greatly decreased. This decrease he suggests as being due, "possibly, to a change in the state of electricity." He concludes by saying, "We do not for a moment suppose that the mycelium is essentially luminous, but are inclined to believe that a peculiar concurrence of climatic conditions is necessary for the production of the phenomenon," and adds that the most luminous parts "were those which were most decomposed. It is possible, therefore, that this fact is an element in the case, as well as the presence of fungoid matter."

One of the chief reasons why such unsatisfactory conclusions have been arrived at with regard to its cause is, undoubtedly, the rarity of the occurrence of luminosity. In connection with the above-quoted experience of the Rev. M. J. Berkeley, the writer says, "observers as we have been of fungi in their native haunts for fifty years, it has never fallen to our lot to witness a similar case before."

Reviewing the various opinions offered as to the cause of this luminosity in fungi, and to the influences by which its production is affected, we find that Fabre attributes it mainly to respiration. But as respiration takes place in all plants, and as, with a few exceptions, mostly of a doubtful nature, this is unaccompanied by luminosity, Fabre's conclusions do not solve the question as to the special factor in the production of the phenomenon in fungi. As to the special mucilaginous substance which German botanists put forward as a solution of the difficulty, this was found by Tulasne to be absent from certain luminous fungi which he examined. Peculiar climatic conditions connected with electrical influences, and not any property of luminosity essential to the plant itself, is a signed by the Rev. M. J. Berkeley as the cause of the phenomenon and the changes connected therewith observed by him, as instanced above. Greater or less decomposition of the matrix also was, he considered, not to be overlooked. The great amount of phosphorescence contained by fungi has also been assigned as a contributing cause.

In addition to the foregoing Tulasne found that parts of fungi which were non-luminous, or only slightly so, when first laid bare by his scalpel became luminous with exposure to air. He considered that oxygen, warmth, and water were as necessary to phosphorescence in living organisms as in dead ones. How important this presence of moisture is will be seen from the following instances:—The occasional luminosity of rotten wood is—though some writers hold the contrary—probably due to some phosphorescent mycelium, it being found that drying removes it beyond re-call. From Tulasne's experiments on *Rhizomorpha subterranea* it was found that dryness destroyed the luminosity before it killed the plant, and this cessation was more rapid than in other fungi.

The phosphorescence of fungi has been observed in different countries, but is most common in Agaricus, or the mushroom family. About seven species of Agaricus are known to have exhibited this property, among which are *A. melleus*; *A. igneus*, from Amboyna; *A. olearius*, al eady cited; *A. noctilucens*, from Manilla, and *A. Gardneri*, from Brazil. The species *Agaricus Gardneri* was discovered by Mr. Gardner whilst travelling in Brazil, to whom it appeared at first sight like a fire-fly of large size. It yielded a pale green light, and, as it grew plentifully on the decaying leaves of a dwarf palm, the whole presented a striking and beautiful effect. It was probably this species which Dr. Cuthbert Collingwood saw in Borneo. He describes the luminosity as being similar to the electric spark, and as intense enough to exhibit the shape of the Agaric. The light did not come off upon the hand, as in the case when one handles phosphorus in the dark; nor did it leave the fungus when it was detached. Mr. Hugh Low informed the same observer "that he saw the jungle all in a blaze of light," by which he could read through an Agaric. As already indicated, other genera than that of Agaricus possess the property of phosphorescence. It has been observed in *Polyporus annosus*, growing in the Cardiff coal mines, and in the so-called Rhizomorpha, an imperfect fungus, which is probably merely the vegetative part of Xylaria, a species allied to Selerotium.

Passing to the second part of our article, the occurrence of luminosity in flowering plants, we find much that is open to doubt, and little that has received careful investigation. Such details as we have, however, whether reliable or not, are not devoid of interest and instruction, for it is from the errors of past observers that those of the future learn to be cautious.

About the earliest mention in botanical works of luminosity among flowering plants is that Linnæus' daughter, one hot summer's night, perceived a curious flashing of the flowers of the nasturtium. The same effect is said to have been observed by others in orange-coloured lilies, in sunflowers, in marigolds, &c. But many careful botanists whose observations extend over a long period have failed to notice the same phenomenon.

The belief in the luminosity of flowering plants is very strong in India, though no authentic instances of its occurrence have been

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adduced. In Afghanistan the natives used to tell of a mountain called Sufed Koh on which grew a bush that appeared on fire at a distance, but the appearance vanished on coming closer. At a meeting of the Royal Asiatic Society, 1845, a rootstock of a plant said to belong to a species of orchis or marica—known to the Brahmins as Jyotismati—growing in the Coraghan jungles at the back of the Madura Hills, was exhibited. To it was ascribed the property of becoming phosphorescent upon being damped, when it gleamed "in the dark with all the vividness of the glow-worm or Scolopendra." As it was not stated whether this effect was actually produced at the time of its exhibition, this account must be accepted with reserve.

Two explanations of the ascribed luminosity of flowering plants are offered. One is that there is no actual luminosity, but that the effect is due to optical illusion. This solution is based upon the fact that most of the accounts—such as that of Linnæus' daughter—attribute the appearance to red or to orange-coloured plants, such as nasturtiums, marigolds, &c. The tints of some flowers, such as the rhododendrons and azaleas, have an appearance of fire in them which is apt at times, by its effect upon the eye, to produce the appearance of flashing.

The other explanation of this phenomenon is that—in certain instances, at least—it is due to an inflammable vapour generated by the plant emitting the light. As there are some curious and detailed observations which tend to bear out this view, the matter is worthy of a little consideration. The European Dittany *(Dictamnus fraxinella)* is said to yield an inflammable vapour, and according to no less an authority than the late Professor Henslow, "if a candle be brought near it, this plant is enveloped by a transient flame without sustaining injury." In the *Gardeners' Chronicle* for 1858 an observer states that he saw some flashes of light passing backwards and forwards over some scarlet verbenas and geraniums in his garden, a smoky appearance following each flash. The air was charged with electricity, and the flashes resembled those of summer lightning.

Dr. Hahn, writing to the *Journal of Botany*, 1863, describes how he succeeded, after several experiments, in producing a "reddish, crackling, strongly-shooting flame" by bringing a light close to some fading flowers of *Dictamnus alba*. On the pedicels and the peduncles were "a number of reddish-brown glands secreting etheric oil," and these were fully open only when the flower began to fade.

A moss, *Schistotega osmundacea*, and other species of the same genus, produces a peculiar brightness which has puzzled many botanists, and which Unger found to be due to the utricles assuming a globular form, and, by refraction and reflection, producing the light observed.

A few marine organisms (Pyrocystis, Peridinium), about which there is doubt as to whether they belong to the animal or to the vegetable kingdom, also exhibit phosphorescence.

Sap, too, is said to be luminous. Mornay speaks of a tree in South America called Cipo de Cunaman, the milky juice of which evolved light on a dark night. And Martius ascribes the same property to a plant which he called *Euphorbia phosphorea*.

Such are the main points known about luminosity in plants. And surely, considering the somewhat meagre state of this knowledge, there is room for students of plant-life to add to it by drawing the attention of others engaged in the same study to such occurrences of the phenomenon as may come under their observation.

The subject may be further studied in the accounts of Fabre, Tulasne, and others, or, where these are not available, in the excellent condensation of their labours in Sach's *Physiology of Plants*, and to Cooke's *Fungi* (International Scientific Series). Hardwicke's *Science Gossip* (1871, p. 121) gives some interesting details of luminosity in flowering plants. To these latter authorities the writer begs to acknowledge his indebtedness.

Arctic Exploration.

DR. FRITTJOF NANSEN, the Norwegian Greenland explorer (who was the guest of the British Association at Newcastle), is busy upon the account of his late journey. He recently proceeded to Stockholm, the King of Sweden and Norway desiring personally to confer upon him the *Vega* medal—the gold medal of the Royal Swedish Geographical Society. We understand that in consequence of the dispatch of the great expedition by Denmark next year to the east coast of Greenland, with a view to explore the northernmost unknown part of that continent, Dr. Nansen has abandoned the project of another Greenland expedition, but is, instead, preparing an expedition to the North Pole in 1891, for which the necessary money has already been volunteered by Scandinavian and British enthusiasts. The route selected will be viâ Franz Josef's Land, by the aid chiefly of the *Ski*, or Norwegian snow runners, upon which the Greenland journey was accomplished, claimed by Nansen and Nordenskiöld to be the Arctic mode of locomotion of the future. This route has never before been tried, although recommended by many distinguished authorities, including the late Dr. Petermann. This continent is only known at the extreme southern end, chiefly from the wintering there of the Austrian "Tegethoff" expedition, but it is surmised that it extends close to the Pole.

The Danish expedition to Greenland, to be dispatched next summer, has been planned by Capt. Normann, a distinguished Arctic *voyageur*, and has for its object the exploration of the east coast from lat. 66° to 73°. As may be remembered, in 1883-85, Capt. G. Holm explored the coast from Cape Farewell to lat. 66°; between this and lat. 70°—about 400 miles—the coast has never been trodden by European. From the 70th to the 73rd deg. the coast was explored by the English whaling captain Scoresby, in 1822, a work continued the next year by Clavering, who reached the 75th deg., and by the German expedition of 1869-70. However, little or nothing is known of the country inland, except that there is a great fjord—the Franz Josef's Fiord—in this latitude, which, according to Greenland tradition, runs right into Davis' Strait, separating Greenland from more northern lands. The east Greenlanders at Angmasalik—the northernmost settlement visited by Holm—told him that once a man had come along this fjord, from west to east, and that it was inhabited by a warlike tribe. The present expedition will consist of eighty members, who will be landed in about 70° lat. by a ship, and provisioned for 3½ years. Here a depôt will be formed and the coast explored, the expedition returning the third summer to Angmasalik, where a ship is to await them. Should the vessel be unable to reach the coast the expedition will proceed southwards to the Danish colonies, by Cape Farewell.

A German deep-sea expedition is now on its way, in the steamer "National," from Kiel to the coast of America, with a view to effect deep-sea explorations from the coast of Brazil up to the coast of Greenland. The leader is the well-known Prof. Hensen, of Kiel University, with whom is a complete staff of zoologists, botanists, biologists, &c. The expedition is equipped by the Berlin Academy of Science, the German houses, and the Emperor. The chief object is research into the temperature, plant, and animal life of the northern seas. No similar expedition has been dispatched from Germany since 1874.

News comes from Tromsö, Norway, that the Bremen Geographical Society's expedition to Spitzbergen, under Drs. Kukenthal and Walter, on board the sloop "Bernitine," has been wrecked, but that another sloop has been secured, in which the exploration will be continued. This expedition was dispatched to Spitzbergen in June last, in order to effect zoological, palæontological, and botanical researches. Much ice has, however, been encountered, and it is difficult to say whether it will succeed in reaching North Spitzbergen, as contemplated.

We are promised a North Polar expedition prior to that of Dr. Nansen, a Finnish naval captain, Assian Limborg, preparing one for

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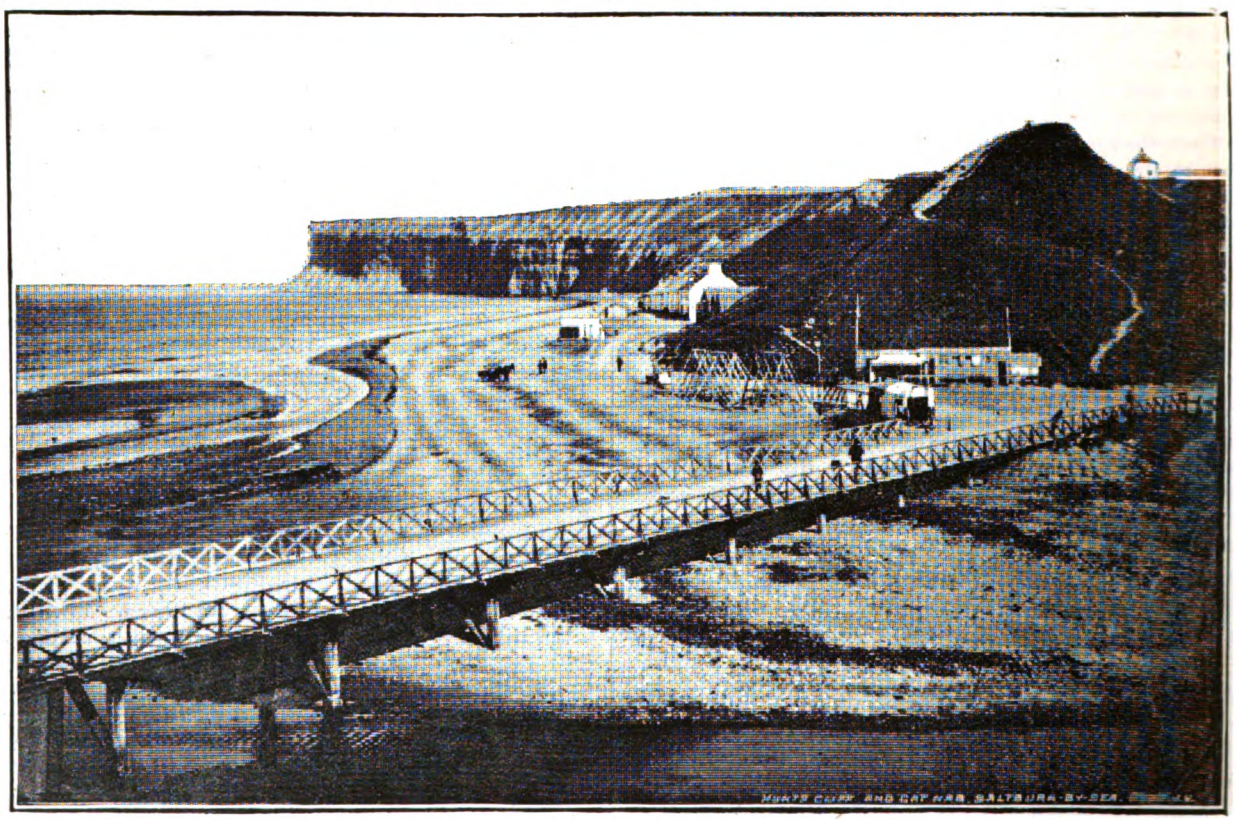
next spring, for the idea of which he is now collecting funds. He has for many years cherished such a venture, and would have undertaken it in 1876 but for the Nordenskiöld expedition. He hopes to obtain the loan of a Russian warship for the voyage. Captain Limborg does not intend to follow the Greenland route, but that over Franz Joseph's Land, travelling viâ Cape Vienna, lat. 84° N., the selected route of the Austrian expedition.

The whalers which annually assemble in the Behring Straits for whale fishing, have induced the American Government to establish a depôt and resource station at Point Barrow, where the American polar expedition of 1881-83 wintered, lat. 71° 16′ N.

The weather in the Arctic regions appears to have been very mild last summer. On the north coast of Iceland no polar ice was seen, a phenomena said not to have happened for twenty years. Reports from Jan, Mayen, and Spitzbergen are to the same effect. Thus the Bremen expedition, which left in the spring, did not encounter firm ice until the seventy-fifth day was reached. In May the sea to the west of Spitzbergen was nearly free from ice. Moreover, Mr. Pike, the English sportsman, who with a party wintered at Damask Island, states that the winter was very mild, even with a thaw, at Chrismas. The maximum cold registered was 28° R.

An expedition to the South Pole is being organized by Mr. Henry Villard, of New York, president of the Northern Pacific Railway, who, it is said, will accompany it.

During last summer and autumn Herr Th. Thoroddsen, the well-known Iceland explorer, visited some parts of that island never before explored. This included the deserts near Fiskivötn, between the Hecla and Vatuajökul, east and north of which he discovered three enormous fields of lava. The lakes swarmed with trout, and the scenery was very picturesque. The district between the "fish lakes" and Vatuajökul is one continuous desert of lava and sand. On Gunlaugson's map of Iceland a little lake here is called Thor's Lake. This, however, Thoroddsen found to be one of the largest in Iceland. He also discovered a long new lake.



Hunts Cliff and Cat Nab, Saltburn-by-Sea.

(From a Photograph by Valentine & Sons, Dundee).

Scientific Aspects of Health Resorts.

IX.—Saltburn and District.

THERE is a delicious sound in the very name of Saltburn-by-the-Sea, and anyone tempted to make a visit to this charming resort will find in its lofty cliffs, its lovely gardens, and in its varied and romantic walks and drives ample enjoyment and exhilarating pleasure. Standing, for instance, in front of the Zetland Hotel, with the rippling, dancing waters of the German Ocean before us, we must be impressed with the beauty of the scene—the fine sands strewed with happy pleasure-seekers, the curious, conical hillock of Cat Nab, which affords such an excellent example of denudation, the bit of old Saltburn on the shore, with its tiny inn and cottages, the dark shelving reefs of the Lias, on which a zealous geologist may be seen busily extracting treasures, terminated by the giant headland of Huntcliff, which stands towering precipitously some 350 feet in height, as if on guard over the interests and welfare of Saltburn. In this district, too, we shall be able to complete our examination of the Yorkshire Lias, which we commenced at Sandsend, near Whitby. We have yet some instructive and splendid sections to visit, and the best course is to take the rail to Hinderwell, and from thence, by a pleasant country walk, drop down into Runswick Bay. We shall have been delighted with the magnificent scenery from the railway carriage as we pass along the coast. Peeps into wooded dells and boulder-strewn

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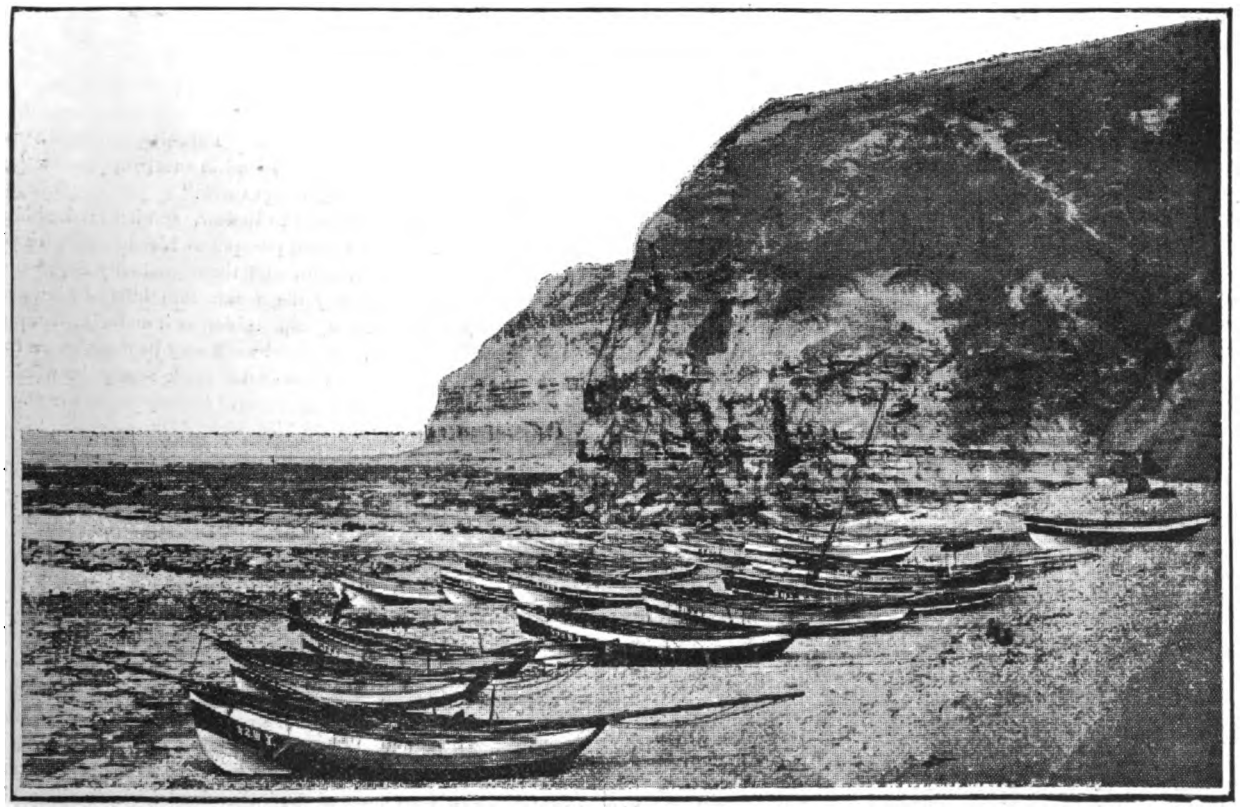
glens with their little streams which have exercised so much power in carving out this beautiful scenery, glimpses of wide ocean with its ever-changing scenes, views of distant woodland and hill—all contribute to the beauty of this journey.

Once more upon the shore, we find that the contour of the cliffs has changed. Instead of the low and receding cliffs of boulder-clay around the Bay of Runswick, which are so easily denuded, we skirt the precipitous cliffs of the Lias, and have abundance of opportunities for increasing our geological knowledge. We find progress rather difficult at times, from the large blocks of oolitic sandstone which have fallen from above, and also from the wide flats of slippery shales, which extend below low-water mark. We shall note some old abandoned ironworks, which were ruined in one night by an extensive landslip; in the cliffs, just above the ironworks, there is a fault with a downthrow of about 50 feet to the east. We may here examine upon the beach the shales of the zone ***Ammonites serpentinus***, and, if time permits, gather some good specimens. The works at Port Mulgrave, or Rosedale Wyke, will next attract our attention, where a shaft is driven into the cliff, and large quantities of the valuable Cleveland ironstone obtained. The shaft gives the position of the main seam as below the sea-level. The immense heaps of this material to be seen give an excellent opportunity of examining this renowned mineral. It has a decidedly oolitic structure, is bluish-grey in colour, and evidently porous. By analysis this rock has been found to consist of a carbonate of protoxide of iron, which, of course, could not have been deposited in the sea in its present form. Upon this arise many interesting questions as to its original composition, what have been the changes, &c. Dr. Sorby concludes, after a minute and deeply-interesting examination of every feature connected with this rock, "that the Cleveland stone was a kind of oolitic limestone interstratified with clays containing a large amount of oxide of iron and organic matter, which, by their mutual reaction, gave rise to a solution of bicarbonate of iron; that this solution percolated through the limestone, and, removing a large part of the carbonate of lime by solution, left in its place carbonate of iron." The importance of this stone may be seen in the creation of the large and busy town of Middlesbrough, with its immense blast furnaces. This "youngest child of England's enterprise," which in 1831 could only muster about 400 inhabitants, could boast in 1881 of 56,000.

As we pass along between Port Mulgrave and Brackenberry Wyke we can examine the sandy micaceous "grey shales" of *A. annulatus*, and approaching Old Nab the ironstone (zone of *A. spinatus*) emerges, forming rugged terraces, which rise quickly into the cliff. Large quantities of small branching fossil fucoids, interlacing and crossing in infinite multiplicity, occur in the "main seam," and from their striking appearance on the weathered surfaces at once attract the eye.

Turning round Old Nab, we soon come to the lofty cliffs of Penny Nab and Colburn Nab, between which the little Staithes Beck runs to the sea, and here, ensconced snugly enough, is the picturesque but, it must be said, not over fragrant village of Staithes. Close by is the magnificent cliff of Boulby, or Rockcliff, which, rising to a height of nearly 700 feet, is thus the highest on the English coast. This imposing cliff is also valuable in another respect, as it shows a clear section of 600 feet of Lias—Lower, Middle, and Upper—which is capped by oolitic sandstone and shales. We shall have also noticed on our way huge red patches of calcined shales at inaccessible elevations of 300 feet in the cliffs in some places. These are the effects of spontaneous combustion. Some of the shales are not only highly bituminous but are also strongly charged with iron pyrites. Thus, when exposed to the air, as in the cliffs, they will spontaneously ignite and sometimes burn and smoulder for years.



CLIFFS AT STAITHES, YORKSHIRE. *(From a Photograph by Valentine & Sons, Dundee.)*

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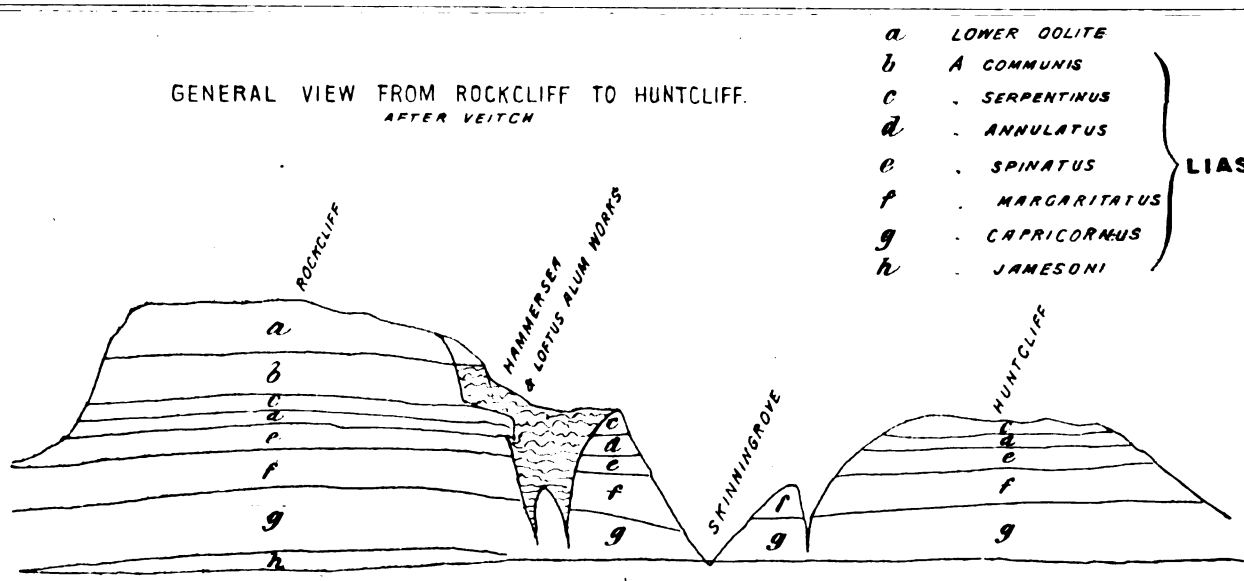
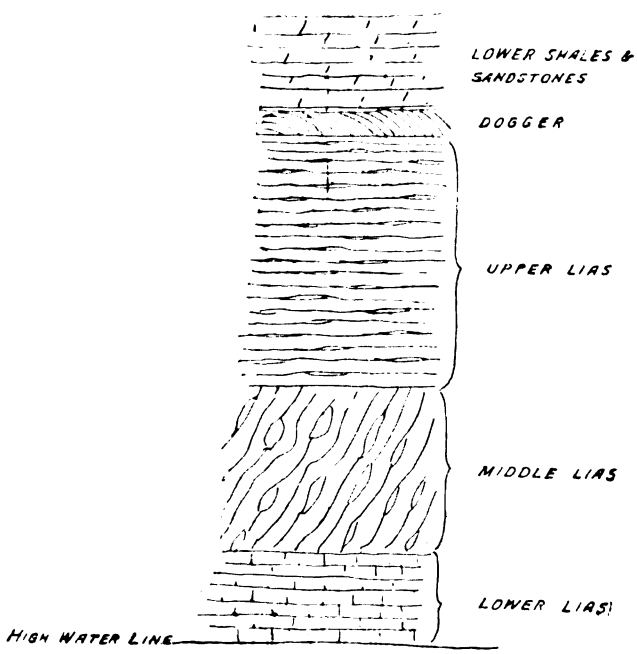
GENERAL VIEW FROM ROCKCLIFF TO HUNTCLIFF.
AFTER VEITCH



At Boulby and Lofthouse we see once more old deserted alum works, and at the above places the quarries and works have once been very extensive. Millions of tons of shale must have been excavated and calcined, and we no longer wonder why such huge saurian remains have from time to time been discovered.

Huntcliff can be visited best from Saltburn along the shore, where we can examine the *A. Jamesoni* shales, which are at the base; above come the zones of *A. capricornus*, *A. margaritatus*, *A. spinatus*, and *A. annulatus*, the latter being exposed in the railway cutting at the top. Tate and Blake say:—"The flat scars under Huntcliff present a scene of the wildest confusion, being encumbered with huge blocks of the Middle Lias sandstones fallen from the cliffs above. Conspicuous amongst them, and especially towards the high-water mark, are hummocks of shale crowned with a shelly indurated layer, which has thus partially preserved the underlying softer mass from the mechanical wear of the waves, and the destructive effects of alternate saturation with water and desiccation by the sun's heat. Fossils occur in great profusion in these layers, but may also be collected in excellent preservation from the surface of the shales at high-water mark."

GENERAL SECTION OF BOULBY CLIFF
AFTER PHILLIPS



Passing Saltburn on our way to Redcar, another marked change is at once apparent. The lofty and precipitous Liassic cliffs give place to much lower ones of glacial drift, and these gradually decrease as we approach Redcar, where they degenerate into hills of blown sand or dunes. Still, even at Redcar, unpromising as it undoubtedly appears at first sight to the geologist, some good work may be done, as on the reefs and scars between high and low-water mark nearly the whole of the Middle Lias and great part of the Lower Lias may be examined. Thus, on the West Scars the Middle Lias from *A. margaritatus* to the base (*A. armatus*), on the "High Stones" the hard sandy calcareous shales of *A. oxynotus* (Lower Lias), and on the "Flashes" the "Bucklandi" beds, also of the Lower Lias, may be carefully searched over, but still not in all weathers; sunny days and low tides are almost indispensable.

We may also have an excursion amongst the bold-looking range of hills to the south, very conspicuous being the escarpment of Eston Nab. These are the Cleveland Hills, which are annually yielding millions of tons of their hidden treasures, enriching the whole district and benefiting mankind at large. These Liassic deposits of ironstone are very extensive, as it is estimated they cover an area of 200 square miles. The view from Eston Nab will not easily be forgotten, and the ironstone quarries on the north-west of this hill should be visited.

We may also proceed a little further to see the famous intrusion of whinstone or basalt, known as the "Cleveland Dyke." The Government geologists say (with which our own observations agree) that "it is a bluish-grey rock, rather compact, and having a tendency to conchoidal fracture. It is finely crystalline, even microscopically, except at the sides, which have a very compact appearance." This rock has, by glacial action, been scattered over various parts of Eastern Yorkshire, and therefore it must be satisfactory to visit the origin of these remarkable travellers. This dyke, roughly speaking, is in its direction straight, although at local points bends may be observed. To the petrologist this dyke is of especial value. In some places it forms a ridge or wall, that is where protected by the impervious Liassic shales, but where Oolitic sandstones occur the reverse happens, as it is decomposed sometimes to a considerable depth. Ayton and Kidale are good points for observations upon the dyke. It varies in thickness; for instance, taking Ayton at the top of the hill it is 20 feet wide, but at the base of the same hill it has been proved to be 80 feet in width.

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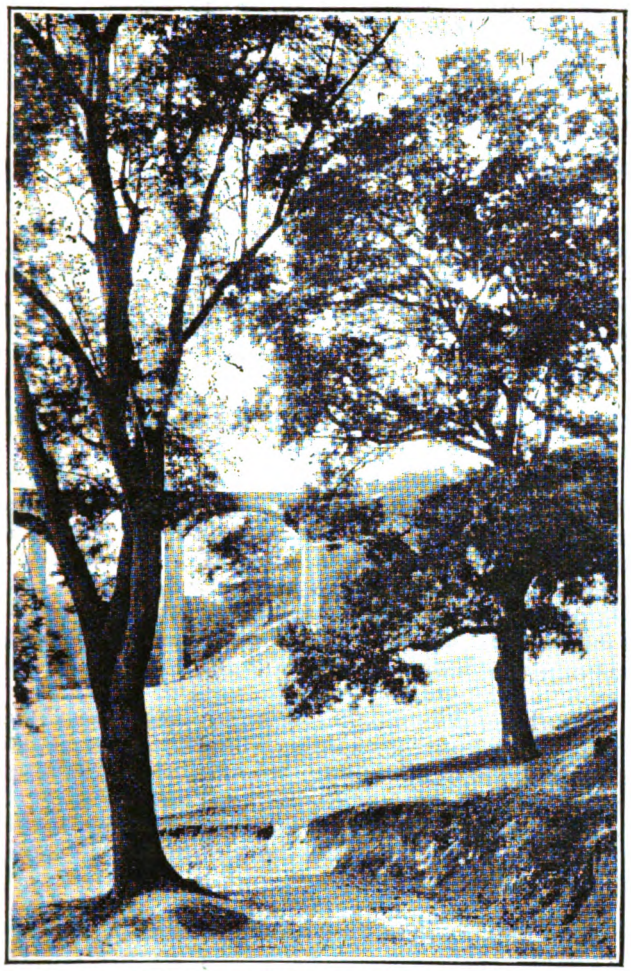
A visit to the town of Middlesbrough, where the geologist, the chemist, and the engineer have combined to build up one of the most colossal industries of modern days, is surely within the scope of our scientific rambles.



NEAR MASKE MILL, SALTBURN-BY-SEA.

(From a Photograph by Valentine & Sons, Dundee).

For details of this interesting district the reader must be referred to the *Geology of North Cleveland*, by G. Barrow, F.G.S. (1/6), one of the Memoirs of the Geological Survey; also to that great classic, Tate and Blake's *Yorkshire Lias*. The Geological Survey Map, No. 34, will, too, be a splendid aid upon our travels. S. A. A.

Buried Toads.

BY OSMUND W. JEFFS.

NOTWITHSTANDING all the attempts which have been made to explain away the stories relative to the discovery of living toads deep down in the heart of solid rock, the fable continues to re-appear at intervals with most refreshing juvenility. No student of biology will for one moment attach any credence to the popular belief that a living animal can exist for long ages buried in a bed of coal or stratum of rock without the possibility of access to food or air, and yet be alive and vigorous after being taken out of its prison. But it is undoubted that very many persons have implicit faith in these stories, being convinced of their truth not so much from any actual corroboration of the circumstances stated to have occurred, but basing their belief apparently on the very unscientific maxim that what a large number of people agree in accepting must necessarily be true. On the 29th July, whilst some workmen at the Barton section of the Manchester Ship Canal Works were lifting a heavy block of stone, weighing 10 tons, they were amazed to discover a live frog "in a small pool of water which had percolated through the red sandstone and settled in a cavity." The frog is reported to have had a film over its mouth, large eyes—"apparently sightless"—and to have changed colour since its exposure to the air. A plaster cast of the cavity was taken, and the frog was photographed, the animal jumping on to the floor as soon as the operation was performed. A correspondent also lately announced in a leading journal that some men who were working in the Harvey Seam of the East Hawle Colliery came across a live toad three inches long; it had "no mouth, and appeared to live entirely upon the air, which it breathed freely. It could hop and crawl about." Only a few months ago *The Times* reported the discovery of a supposed "prehistoric toad," which was vouched for by an authority of no less literary eminence than Miss Amelia B. Edwards, who indignantly repudiated the suggestion of a correspondent that there could be any possibility of the toad having got into the place where it was found at a comparatively recent date. A mass of what is termed "evidence" bearing upon similar reputed discoveries has been industriously collected by Mr. W. S. Gresley, F.G.S. In this list (which I quote from *Science Gossip*) particulars are given of the following amongst other discoveries, with the date, locality, and authority for each record:—A large, fat toad in Derbyshire, found in a compact block of sandstone, which lived for a few seconds only after its release; seven live frogs near Pontefract, in compact rock (sandstone or limestone) free from fissures, the frogs being in separate nodular masses between the strata; a large toad in a cavity in a flint weighing 14 lbs., in which no crack or flaw could be detected; 30 to 40 live young frogs, found in a cavity in a block of sandstone 330 feet deep, at Shield Muir Pit, Motherwell, Scotland; a live toad in a solid block of coal in the Forest of Dean, the creature seeming to be firmly embedded in the coal and its form imprinted on the face of the mineral.

In all these and other instances the evidence is very weak, and not a single case claims to have been discovered or investigated by a scientific man. The toads seem to have been mostly found by the miners or colliers, who are not usually given to making that strict inquiry into the discovery which is necessary from a scientific point of view, and which, in fact, the well-known antipathy of uneducated—and even some educated—persons to all batrachians would (even if they desired) in many cases preclude them from undertaking.

Nothing is more common in coal-mining districts than to hear of live frogs, toads, and sometimes live snakes being brought up from the bottom of pits, and these creatures are always supposed to have been actually buried in the heart of a seam of coal until released by the miner's pick and brought up into the light of day. The interested visitor will be told with all sincerity that the animal has been so buried for an unknown number of ages—in fact, since "afoor t' flood!"

A variation of the familiar "toad in the coal" story recently appeared. In this case the scene was changed from the dismal depths of a coal pit to the brightness of a drawing-room fireside in the town of Birkenhead, where, to the great dismay of the housemaid who was making the fire, on breaking open a lump of coal, a live toad jumped out on the hearth rug!

Scientific fables, like many others, die hard, but it is time that the death blow was given to such delusive notions, which should have been finally disposed of by the decisive experiments of Dr. Buckland many years ago. It is by no means necessary to impute fraud on the part of the many relators of such stories, who are usually self-deceived. There is really little to be wondered at in the presence of toads in mines, considering that they can get down by the same means as the human beings and horses. In the darkness of the pit it is not always possible to assert

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that the spot where the animal was found really had no opening or communication with the air outside, and as the fragments of rock or coal surrounding the supposed toad cavity are generally broken up or scattered, it is impossible to replace them so as to ascertain the point decisively. Examination of the mass containing the animal after it has been broken open is of no use at all in the settlement of the disputed point. The presence of toads and frogs embedded in trees is easily explained by the fact that the young toad on emerging from the tadpole state often seeks shelter in holes and crevices of trees and rocks, from which it might not be able to get out. Abundant food would be found in the small insects which repaired to such cavities and the water which collected there. These animals require little respiration, and consequently food, to support life, and after a while they might easily increase so much in bulk that egress was impossible. The small opening, too, would be easily overlooked by workmen.

Geologically speaking, the presence of live toads in coal is discountenanced because no toads are known to have existed on the earth during the Carboniferous period, and the changes which the rocks have undergone since their formation (to say nothing of the lapse of time) renders it quite impossible that any living organism could be so long preserved as the narrators of these "toad stories" would have us believe.

In the year 1825 Dr. Buckland made a series of experiments on the longevity of toads. He placed one animal, duly weighed, in each of twenty-four air-tight cells made in blocks of solid limestone and sandstone, a double cover of glass and slate being cemented over each cell by a luting of clay, and the whole buried three feet deep in the earth in his own garden. There they remained for twelve months. On being opened the toads in the smaller sandstone cells were all found to be dead and much decayed. The greater part of those which had been buried in the limestone cells were, however, alive; two of them had even increased in weight. In one of these the glass had been cracked, affording the possibility of entry by minute insects. The luting of the cell of the other of these two was not examined, but probably there was an aperture by which small insects were admitted. Of the small toads all were dead, and the large ones died before the end of the second year. Four other toads had at the same time been placed in holes cut in the trunk of an apple tree, and closed by plugs of wood so as to exclude access of insects. All these toads were found dead at the end of the first year.

Some of the toads lived longer than it was expected, but the experiments conclusively proved that these animals cannot survive longer than two years excluded from food. The assumption, therefore, that "prehistoric" toads can be found at the present day alive on emerging from solid blocks of coal or other mineral is not found to be based on evidence of any scientific value whatever.

Notes in Brief.

At a public meeting held in Manchester it was decided to form a fund for the erection of a statue of the late Dr. Joule, as a companion to that of Dalton, by Chantrey, in the Town Hall, and also of a *replica* in bronze to occupy some public place in the city.

At the December meeting of the Salford Town Council the following resolution. moved by Councillor Cottrell, was carried unanimously:—"That this Council, recognising the necessity of providing technical instruction for the artisan class of the borough, hereby appoint a committee to consider the subject and report." Councillor Cottrell said the sum of one penny in the pound on the rate would realize £2,800, which would be sufficient at all events for the present requirements of the borough.

A railway is projected to the summit of the Jungfrau, 13,000 feet high, the top of which is covered with perpetual snow and ice.

The Whitworth Institution has now received the Royal sanction, and the Governors have the power of laying out a sum of about £135,000 in organising schools of art and technical science, museums, and workshops. It is also intended to appropriate the grounds of Sir Joseph Whitworth's mansion at Rusholme for a public park.

From the annual report of the Pasteur Institute we learn that during the period from November, 1888, to November, 1889, the number of patients treated, after being bitten by rabid dogs, cats, &c., was 1830. Of these 11 died of hydrophobia, notwithstanding the treatment. The average mortality is lower than that of last year.

Another appointment for ladies in medicine! Miss Vida A. Latham, B.Sc., F.R.M.S. (formerly of Manchester), youngest daughter of the late Dr. Latham, of Wigan, has been appointed Assistant Professor and Demonstrator of Pathology in the University of Michigan. Miss Latham is the first lady who has held a similar position in the University.

According to the *Athenæum*, Mr. Isaac Roberts, F.R.A.S., of Maghull, near Liverpool, is about to transfer his observatory to Crowborough Hill, Essex.

University College, Liverpool.—The Sheridan Muspratt Chemical Scholarship, of the value of £50 per annum for two years, has been awarded to Mr. J. T. Conroy, who has recently taken the degree of B.Sc, with honours, in chemistry, at the University of London. The scholarship is the gift of Mrs. Sheridan Muspratt, and is intended to enable the holder to continue study in the higher branches of chemistry. The Sheridan Muspratt Exhibition, of the value of £25, has been awarded to Mr. A. Carey, of Widnes.

In the lantern-slide competition initiated by *Photography*, open to all amateur and professional photographers in Great Britain, the president-elect of the Liverpool Amateur Photographic Association, Mr. Paul Lange, has been awarded a medal for *Cloudscape*, and also other prizes. In connection with Norwegian scenery, Mr. Lange's recent work is noteworthy, as showing very clearly many features illustrative of the geology and physiography of that country.

Long before Columbus discovered the east coast of America, it had been visited by the Norsemen, who colonised a part of Massachusetts, where stood the ancient city of Norbega. Here have been found remains of canals, dams, houses, and fish-traps made by these hardy Norsemen, whose deeds have been commemorated recently by the American Geographical Society.

Two electric lighting companies established in Newcastle-on-Tyne are now proceeding with the laying of underground cables for the public installation of the electric light.

Mr. John Stuttard has reprinted his paper on "The Butterfly," read before the Rochdale Literary and Philosophical Society, and has dedicated the work to Sir John Lubbock.

Three schools of mines have been established in New Zealand, the rich mineral resources of which country are now being rapidly developed.

Of all the stories of discovery which the intrepid Stanley will have to relate on his return to Europe, none will be more remarkable than his account of the curious tribes of dwarfs of Central Africa. At present our information respecting them is scanty. Professor Flower considers these diminutive races to be the remains of a population which occupied the land before the incoming of the present dominant races.

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A PHOTOGRAPHIC survey is about to be commenced of the neighhood of Birmingham, to record all the features of antiquarian, historical, or picturesque interest. This will be done on systematic lines, as propounded by Mr. W. Jerome Harrison, F.G.S. It is to be hoped that some means will be adopted to include geological features in the new survey.

THE autumn course of lectures given under the auspices of the Liverpool Corporation has now concluded. The lectures have all been successful, and some of them have attracted large audiences. Dr. A. R. Wallace gave two admirable discourses on the colours of animals, and the subject of Evolution was also treated from a somewhat different standpoint by Mr. G. J. Romanes. The Rev. H. R. Haweis, M.A., gave two lectures on Music, and the literary element also received attention at the hands of Mr. Edmund Gosse, who discoursed upon "Victorian Poetry." Mr. J. N. Lockyer's lectures on "The Meteoric Hypothesis" were well attended, as were also those of Dr. O. J. Lodge on "The Electric Telegraph," and Professor Rhys Davids on "The Growth of Human Culture."

FROM the first annual report of the Wirral Footpaths and Open Spaces Preservation Society, the president of which is the Duke of Westminster, we are pleased to learn that some good work has already been done in recording cases of local interference with public rights over common path-ways, and in endeavouring to secure public rights of way over these places. It it highly satisfactory that all this has been accomplished without recourse to litigation, amicable arrangements having in most cases been made with the owners of land. The society has now enrolled 157 members, and is one highly deserving of support by naturalists, travellers, and all who love the country. The report gives full particulars of field paths, &c., in the society's district. We should like to see societies of this kind spread over the whole of the land.

THE Severn Valley Field Club have now issued their reports for 1888 and 1889, edited by Dr. C. Callaway, whose presidential address on "The Work of Field Clubs" is an eloquent and able introduction to the study of natural history, and will, no doubt, spur those who read it to the highest efforts. Reports are given of excursions to the Wrekin, Dolgelly, Stokesay, Acton Burnell, Buxton, and Wenlock, all of an interesting character and containing much valuable information.

AT the meeting of the committee of the Liverpool School of Science and Technology, held on December 3rd, Mr. Henry Duckworth, J.P., in the chair, it was announced that the following prizes of the Union of Lancashire and Cheshire Institutes had been awarded to the school:—Prize for electricity and magnetism, to Alfred Meyer; exhibition £3 for machine construction, to Joseph Gibson; prize for stage 3 mathematics, to D. G. Davis; prize for stage 2 mathematics, divided between Henry V. Barker, Harold Cliff, and Edward J. Cooke.

THE competitions for prizes for models, drawings, and scientific collections sent in last session by the students of the Liverpool Science and Art Classes are now on exhibition in the Liverpool Free Public Museum, where they have been excellently arranged by the curator, Mr. T. J. Moore. They comprise several excellent models of steam engines, drawings of engine boilers and other machinery, illustrations of chemical apparatus and processes, and geological features and collections showing results of teaching in agriculture, &c.—all indicative of careful instruction by the teachers and steady, intelligent work by the students.

A WELL-WRITTEN digest of the proceedings of the British Association at Newcastle, so far as they relate to geology, has been compiled by Mr. Mark Stirrup, F.G.S., of the Manchester Geological Society, and appears in the *Transactions* of that society.

WE are pleased to note that a deputation of the ladies of the congregation of Ruthven, Mrs. Mollison, Mrs. Leslie, and Miss Douglas, along with Messrs. Leslie and Mollison (elders), and Mr. James Reid, Jun. (representing the Free Church members in the parish), waited upon the parish minister, Dr M'Pherson, F.R.S.E., a valued contributor to this journal, and presented him with a full set of pulpit and academic robes and a study timepiece, in recognition of his faithfulness as a preacher and pastor, and of his eminence as a scholar and author. The deputation assured him of the high respect in which he was held in the district, the gratification of the parish at his literary success, and their earnest wishes that his life may be long spared to go in and out in his kindly way among all classes and all denominations. At the same time Mrs. M'Pherson was presented with a silver salver, as an expression of the deep sympathy of the people with her in her continued delicate health, with the anxious hope that she may soon be restored to good health.

HENCEFORTH the official journal of the Wesley Scientific Society will be merged in the *Journal of Microscopy and Natural Science*, the *Wesley Naturalist* having been discontinued.

DR. GREENWOOD, Principal of Owens College, Manchester, has resigned the position which as Principal and Professor of Greek Testament criticism he has held for a period of thirty-nine years. In the resolution of the council expressing their great regret at receiving the resignation, it was stated that they recognised that "his unblemished character, his high scholarship, his unfailing tact and temper, his entire devotion to the interests of the college, his unflagging attention to the duties of his office, his pleasant relations with the students, with the teaching staff, with the senate, and with the council have contributed most essentially to the usefulness and development of the college, and have endeared him to all connected with it."

AT the first meeting of the new session of the Manchester section of the Society of Chemical Industry, on December 3rd, Mr. I. Levinstein, who presided, gave an interesting address on the establishment of sectional committees in connection with Chambers of Commerce. He said that a strong committee representing the chemical and other allied branches of manufacture and trade in this neighbourhood had been formed and approved of by the Manchester Chamber of Commerce, and it would be in the power of this committee to render considerable assistance in the development of the chemical and allied industries of the district. Amongst the matters the committee might carefully consider were:—whether the patent laws in their present form were best calculated to assist the development of our industries; the correct classification of chemical products based on some rational principle, in lieu of the present haphazard and in many respects absurd system adopted by railway companies and others; also more uniform methods of analysis of chemical products; abolition of duty on pure alcohol and wood-naphtha used for manufacturing purposes; publication of consular and other reports concerning chemical industries, &c. He also said that, in addition, special attention ought to be paid to the dyeing of fancy coloured yarns, as this trade, which was formerly chiefly carried on in Scotland, had within the last few years been transferred to a large extent to Manchester, and promised to become an important feature of local trade. He sincerely hoped that the steps thus taken by the Board of the Manchester Chamber of Commerce would lend a new impetus to the development and expansion of our industries.

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FREE admission to the Liverpool Autumn Exhibition of Pictures on the four Saturday evenings in December has been the indirect result of an application by the Liverpool Sunday Society that the exhibition should be opened free to the public on the four last Sundays of the year. The application was entertained by a large majority of votes at the Arts Committee, but when brought before the Council was met by an amendment in favour of giving free admission on Saturday evenings between the hours of 5 and 10 o'clock. The amendment was carried by a majority of four, the voting being for it 17 councillors and 9 aldermen, and against 22 councillors and 1 alderman. On the first free night about 2,000 persons—double the usual number—were present.

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Museum Notes.

AT the Liverpool Museum the weekly Monday evening lectures have been continued. The attendance on these occasions has by no means been so large as was anticipated. During the three hours when the building is open in the evening the number of visitors rarely exceeds 350. Some years ago, when the experiment was first tried, the attendance became so large and unmanageable that the building was closed. Now the result is very different; the rough element is no longer present, and the few earnest students and others who do enter the gates give evidence of their appreciation of the opportunity to attend during hours when they are free from their ordinary occupations. The building is not well adapted for speaking in public; in the galleries only those in the immediate vicinity of the speaker can hear the discourse, and it might be well if some arrangements were made so that the museum addresses should be given in the small lecture-theatre, followed by a short demonstration before the actual cases containing the specimens. During December the following subjects were popularly treated:—"The Life History of a Fluke," by Mr. R. McMillan; "Sea Slugs," by Mr. J. Hornell; and "Silk and Silkworms," by Mr. Willoughby Gardner.

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AN exhibition of the collection of Egyptian antiquities formed by Mr. Flinders Petrie has been on view at the Owens College Museum, Manchester. A meeting of the Lancashire and Cheshire Antiquaries' Society took place in the museum, at which Professor Boyd Dawkins gave an address on the collection. Referring to the assistance rendered to the exploration by the merchant-princes of Manchester, he said that it was a good augury when they found trade going hand-in-hand with progress, and the result of trade devoted to the exploration of the ancient history of the world.

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THE number of visitors to the Manchester Art Museum is reported as steadily increasing. A conference was lately held in the Town Hall in support of a scheme for lending works of art to public elementary schools. Several collections of pictures, illustrating trees, birds, wild flowers, landscape scenery, historical subjects, and portraits have been formed for the purpose of being lent to the schools. The question of art lectures to working men's clubs and schools has also been considered, and it was decided to have a number of lantern slides made to illustrate lectures on architecture, sculpture painting, the development of the arts of weaving, pottery, glass and metal work, and similar subjects.

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AT Peel Park Museum, Manchester, a series of lectures has been arranged by the Salford Corporation. Mr. R. C. Philips, who was for sixteen years a merchant on the Lower Congo, discoursed on the subject of "Stanley and the Emin Pasha Relief Expedition." On another occasion Mr. H. H. Howorth, M.P., gave an address on "The Mammoth:—The Flood and the Earliest Records of Man"

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TWO ethnographical exhibitions have been held at Vienna. The one is a collection of several thousand objects from the South Sea Islands, together with zoological and ornithological specimens. The other exhibition is that by Dr. Troll, the Austrian explorer of Central Asia. The Vienna papers recommend the purchase of these by collections out of the imperial funds.

DR. BURGHARDT gave a Saturday afternoon lecture at the Owens College Museum on "Lead: Its Ores and Metallurgy," and on Thursday, December 8th, Mr. W. E. Hoyle, M.A. (keeper of the museum) gave a demonstration in the museum on "Feathers, Scales and Hairs."

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IN pleading for the completion of the museum buildings at South Kensington, the *Art Journal* says that, in consequence of the scattered character of the arrangements and the inconvenient situation of the offices, the work of the department is carried on under great difficulties. Only a little while ago the judging of the competition drawings sent up from all schools in the country to compete for medals and prizes, took place in some dilapidated sheds, from the ceiling of which the plaster was dropping, and through whose roof the rain came in torrents; and we hear that the accommodation for the staff of clerks and writers is so cramped that the work has to be carried on in corridors and on staircases, under conditions which must be pronounced as anything but satisfactory for the discharge of the duties of an important public office.

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AN interesting ancient relic has been discovered by the Chester Archæological Society, and will be placed in their museum. For some years they had in their possession an old "box of whistles," the use and purpose of which remained quite unknown until lately, when it was examined by Dr. Bridge, of Chester, who pronounced it to be a set of "recorders" in a good state of preservation. The "recorder" is the outgrowth of the shepherd's pipe and the origin of the modern flute. It was frequently used in the middle ages. The specimen now at Chester is probably unique in England in its perfect condition; for, although no sounds have issued from it for a couple of hundred years, it will still, in skilful hands, discourse sweet music. The "recorder" is constructed of ebony, with ivory joints.

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A NEW natural history museum has been opened at Berlin, with full ceremonial honours, in the presence of the Emperor and Empress and suite. Dr. Von Gosslor gave an address, in which he mentioned that the collections were formed a hundred years ago. Professor Boyrich, the first curator of the museum, pledged himself to keep abreast with the progress of science—a truly Herculean task, nowadays!

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IT is becoming a practice, as frequent as it is laudable, to despatch an official of the staff of a museum to foreign places for the study and collection of objects. Thus, Professor Bornmuller, of the Botanical Museum, at Belgrade, has just started on a long tour through Asia Minor, and Mr. Watson, assistant-curator at Kew, recently visited the south of France, inspecting the botanical gardens between Hyéres and Mentone.

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THE sixth meeting of the Mersey District Librarians took place on November 29th, at the Oldham Free Library and Museum. The Free Libraries represented were those of Manchester, Oldham, Rochdale, Stockport, Warrington, Liverpool, Birkenhead, St. Helens, and Bootle, and the Athenæum and Lyceum Proprietary Libraries, Liverpool. Papers on "Ladies' Reading Rooms in Connection with Free Libraries," by Mr. Thomas Formby, and on "The Apprenticeship System for the Systematic Training of Library Assistants," by Mr. R. Bateman, sub-librarian, Oldham, were read. The difficulties and advantages connected with both subjects were fully discussed. This organisation of librarians has now been made a permanent one, and its originator, Mr. Charles Madeley, of the Warrington Free Library, has been appointed honorary secretary. The next meeting takes place at St. Helens in February.

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THE death is announced of Sénor José Augusto de Souza, curator of the zoological museum at Lisbon. He was the author of a work on African birds, and compiled several catalogues of the Lisbon museum.

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IT is announced that Dr. Pax, of Breslau, has been appointed curator of the botanic garden at Berlin.

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SPEAKING on the subject of "Gold," at an afternoon "lecturette," at the Liverpool Museum, Mr. C. E. Miles (of the Liverpool Geological Association) entered very fully into the different modes of occurrence of gold in reefs and alluvial deposits, noting its frequent association as an ore with iron pyrites and complex minerals, the methods of its extraction, and the concentrating and smelting of gold ores. The probabilities were great that gold will always remain a rare metal, and the opinion was expressed that in the future the economic extraction of gold will call forth all the inventive genius of man for its successful achievement. Several samples of gold ores were exhibited, including specimens from the Transvaal and the celebrated Dolgelly mines, in North Wales.

MR. C. CARUS-WILSON, F.G.S., gave an address at the Salisbury and South Wilts Museum on "Sand and Sandstones," in which he gave a clear description of the mode of origin of most of the rocks forming the crust of the earth, and specially dwelt upon the formation of sand from the disintegration of quartz and other minerals. The history of the sandstones of each geological period was given, and reference made to the peculiar features of certain varieties of that rock, such as the coral sands of the Bermudas, the Fontainbleau sandstone, and the flexible sandstone, "itacolumite," of Brazil. The curious discovery of "musical sand" at Swanage and other places was also alluded to, and the cause of the vibration producing the sounds was explained.

On the Reciprocal of 365 and its Practical Application.

BY ALEX. SHENNAN HUME.

SPEAKING generally, it may be said that by the employment of reciprocals we are enabled to get results by multiplication instead of by the less direct and more operose process of division, an advantage manifest to all computers.

A Table of Reciprocals is therefore an invaluable aid to calculation, and for ordinary purposes I need only refer the reader to the splendid table by Lieut.-Col. Oakes, in which the reciprocals of all numbers up to 10,000,000 are given to seven significant places of figures.

The study of reciprocals is a very interesting one, and those of the prime numbers especially deserve to be examined individually. Many reciprocals possess properties peculiar to themselves, and it may sometimes happen that by the exercise of a little ingenuity the special features of a reciprocal can be turned to practical advantage.

I shall at present confine myself to the consideration of the reciprocal of 365, and give applications of its peculiarities which will be of everyday use.

I.

The reciprocal of 365 is ·0 0273 9726, a circulating decimal whose repetend consists of eight digits. Separating the repetend into two tetrads, it will be found that the second tetrad is complementary to the first; that is to say, if we deduct each of the digits 0, 2, 7, 3 from 9 we get 9, 7, 2, 6 respectively, the digits of the second tetrad.

Moreover, on referring to the subjoined table of days, No. 1 (which consists of the multiples of ·0 0273 9726), it will be found that the same peculiarity prevails throughout. A further noteworthy point in the table is that the second tetrads if read *upwards* are the same as the first tetrads read *downwards*.

One or two examples will illustrate the use of the table and the rule given at its foot.

What is the decimal of a year corresponding to 47 days? ·1 2876 7123.

What is the decimal corresponding to 245 days? Adding the figure at the head of the column in which 245 occurs, viz., ·6, we get ·6 7123 2876. Similarly the decimal corresponding to 350 days will be ·8 + ·1 5890 4109 = ·9 5890 4109.

No. I.

Number of Days.				Decimal.
	Add ·2	Add ·4	Add ·6	Add ·8	
1	74	147	220	293	·0 0273 9726
2	75	148	221	294	·0 0547 9452
3	76	149	222	295	·0 0821 9178
4	77	150	223	296	·0 1095 8904
5	78	151	224	297	·0 1369 8630
6	79	152	225	298	·0 1643 8356
7	80	153	226	299	·0 1917 8082
8	81	154	227	300	·0 2191 7808
9	82	155	228	301	·0 2465 7534
10	83	156	229	302	·0 2739 7260
11	84	157	230	303	·0 3013 6986
12	85	158	231	304	·0 3287 6712
13	86	159	232	305	·0 3561 6438
14	87	160	233	306	·0 3835 6164
15	88	161	234	307	·0 4109 5890
16	89	162	235	308	·0 4383 5616
17	90	163	236	309	·0 4657 5342
18	91	164	237	310	·0 4931 5068
19	92	165	238	311	·0 5205 4794
20	93	166	239	312	·0 5479 4520
21	94	167	240	313	·0 5753 4246
22	95	168	241	314	·0 6027 3972
23	96	169	242	315	·0 6301 3698
24	97	170	243	316	·0 6575 3424
25	98	171	244	317	·0 6849 3150
26	99	172	245	318	·0 7123 2876
27	100	173	246	319	·0 7397 2602
28	101	174	247	320	·0 7671 2328
29	102	175	248	321	·0 7945 2054
30	103	176	249	322	·0 8219 1780
31	104	177	250	323	·0 8493 1506
32	105	178	251	324	·0 8767 1232
33	106	179	252	325	·0 9041 0958
34	107	180	253	326	·0 9315 0684
35	108	181	254	327	·0 9589 0410
36	109	182	255	328	·0 9863 0136
37	110	183	256	329	·1 0136 9863
38	111	184	257	330	·1 0410 9589
39	112	185	258	331	·1 0684 9315
40	113	186	259	332	·1 0958 9041
41	114	187	260	333	·1 1232 8767
42	115	188	261	334	·1 1506 8493
43	116	189	262	335	·1 1780 8219
44	117	190	263	336	·1 2054 7945
45	118	191	264	337	·1 2328 7671
46	119	192	265	338	·1 2602 7397
47	120	193	266	339	·1 2876 7123
48	121	194	267	340	·1 3150 6849
49	122	195	268	341	·1 3424 6575
50	123	196	269	342	·1 3698 6301
51	124	197	270	343	·1 3972 6027
52	125	198	271	344	·1 4246 5753
53	126	199	272	345	·1 4520 5479
54	127	200	273	346	·1 4794 5205
55	128	201	274	347	·1 5068 4931
56	129	202	275	348	·1 5342 4657
57	130	203	276	349	·1 5616 4383
58	131	204	277	350	·1 5890 4109
59	132	205	278	351	·1 6164 3835
60	133	206	279	352	·1 6438 3561
61	134	207	280	353	·1 6712 3287
62	135	208	281	354	·1 6986 3013
63	136	209	282	355	·1 7260 2739
64	137	210	283	356	·1 7534 2465
65	138	211	284	357	·1 7808 2191
66	139	212	285	358	·1 8082 1917
67	140	213	286	359	·1 8356 1643
68	141	214	287	360	·1 8630 1369
69	142	215	288	361	·1 8904 1095
70	143	216	289	362	·1 9178 0821
71	144	217	290	363	·1 9452 0547
72	145	218	291	364	·1 9726 0273
73	146	219	292	365	·2 0000 0000

The Decimals correspond to the number of days in the first column.

If the number of days fall in the 2nd, 3rd, 4th, or 5th column add the figure at the head of the column as a correction to the decimal.

(To be continued.)

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The Electrification of Air by Flame.

IT is now twenty-seven years ago since Sir William Thomson, President of the Royal Society of Scotland, first experimented on the electricity of air within doors. The results were not quite satisfactory. In the spring of last year (1889) these experiments were continued, under his superintendence, by Mr. Magnus Maclean and Mr. Goto (now of Tokio, Japan), within the several parts of the University buildings, for the purpose of endeavouring to find a relation between the electrification of air within a building and the atmospheric potential in its neighbourhood outside; and of finding causes which produced or changed the electrification of any given quantity of air.

These young scientists conducted a large number of series of observations on the potentials of water-dropping collectors within the Natural Philosophy Laboratory, and at different points outside the building. Up to that time no definite relation had been discovered between the external potential—that is, the potential of air outside and inside the building. The weather was settled, and the external potential was almost always positive in all positions from a few feet above the ground to the top of the Tower of the University; whereas the potential inside the building was almost always negative. This last set of observations agreed with those made at the old college, down in the densest part of the city.

In July last these observers were struck with a curious result in the course of their experiments. In one ordinarily unused room, 31½ feet long by 24 feet broad, and 20 feet high, practically quite free from any sensible disturbance by electric light wires, or by electrical operations being performed in the laboratory, the electric potential of a water-dropper, having its nozzle at the centre of the room and about 7 feet above the floor, was always found about 2 volts negative at the commencement of the observation, and always increased to about 9 volts in the course of twenty minutes. Within the room two quadrant electrometers, each with an ordinary paraffin lamp and scale, were used—one being connected with the outside water-dropper, and the other with the water-dropper inside the room.

What was the reason of this change? Between 10 and 11 a.m. the paraffin lamps were extinguished, one being merely lighted with a match every five minutes for the purpose of reading the electrometer deflection. It was found that in the change of circumstances there was not the increase of negative potential which had been found in every previous series of observations (from 2 to 9 volts) when the lamps were burning. This seemed to prove that the burning of the lamps produced a negative change in the air of the room.

Since that time Mr. Goto, with the electrometer and its lamp and scale outside, and with paraffin lamps burning or not burning within the room, has confirmed this result. Similar experiments are being made with other kinds of flame, and even with a number of people in the room heating the air by their breath. These observers are to continue their observations on natural atmospheric electricity in various localities, outside and inside different buildings, and Sir William has promised to give the result of their observations to the Royal Society of Edinburgh at an early date.

Our Portrait Gallery.

XVII.—SIR FREDERICK AUGUSTUS ABEL, C.B., D.C.L., D.Sc., F.R.S., &c.

FREDERICK AUGUSTUS ABEL was born in London, in July, 1827, and is the son of the late John Leopold Abel, Esq., who devoted himself personally to the early education of his children. In his fourteenth year he went to Hamburg to reside with his uncle, A. T. Abel, a well-known mineralogist and a pupil of Berzelius, and his attention was then first directed to the pursuit of science. He attended the Johanneum, at Hamburg, and also received private tuition there. On his return to England he commenced chemical studies, first at home and afterwards for some months at the Polytechnic Institution. On the foundation of the College of Chemistry he was one of the first to enter as a student, and in 1846 was the first student selected by Professor A. W. Hofmann as a junior teacher and lecture-assistant. Subsequently he assisted Hofmann, conjointly with Mr. E. C. Nicholson, in carrying on the series of Researches on the Aniline Derivatives, which that eminent chemist published between that date and 1851. During this period Mr. ABEL published several papers in the *Journal of the Chemical Society*, including *Analyses of the Artesian Wells, Trafalgar Square*, and of *The Mineral Waters of Cheltenham*, carried out together with Mr. T. H. Rowney; a research *On the Oxidation of Cumol by Nitric Acid*, and researches *On the Composition of Strychnine*, carried out in conjunction with Mr. E. C. Nicholson.

His first connection with the Woolwich Establishments dates from 1849, when he initiated the instruction in practical chemistry of Royal Artillery Officers and of the Senior Cadets at the Royal Military Academy. In 1850 he left the Royal College of Chemistry to join Dr. Stenhouse, who was at that time appointed Lecturer in Chemistry at St. Bartholomew's Hospital, and Mr. ABEL was the first to organise a system of tuition in practical chemistry at that Medical School. While occupying the position of Demonstrator of Practical Chemistry at this school, he was successful in a keen competition for the appointment of Professor of Chemistry at the Royal Military Academy, Woolwich, upon the retirement of Faraday, whom he succeeded in 1852.

He was soon frequently consulted by the military officials in charge of the Government Works at Woolwich Arsenal, Waltham Abbey, &c., on scientific questions relating to the production of war material, and the experiences acquired during the stormy times of the Crimean War soon demonstrated the importance of affording the Ordnance Department of those days and its various Establishments the advantage of constant scientific advice and assistance in maintaining the effective supply of armaments, munitions, and equipments. The appointment of *Ordnance Chemist* was consequently created in 1854, and to Mr. ABEL was entrusted the task of initiating and organising the work of this establishment, which subsequently, as *Chemist to the War Office*, he developed into a Government Department of high importance and widespread utility. Not only was a great reform effected, through his agency, in the system of supply of the materials needed for the manufacturing establishments of war materials, and for the construction of works and buildings, whereby the proper standards of quality were established and maintained, but the supply of food, clothing, illuminants, detergents, and many others of the chief requisites of the

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SIR FREDERICK AUGUSTUS ABEL, C.B., D.C.L., D.Sc., F.R.S., &c.

From a Photograph by W. & D. Downey, Ltd., S.W.

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troops became also subject to efficient control in regard to quality. The examination into inventions of a scientific nature, and the multifarious work of a general scientific referee at the command of all branches of the War Department, became a very important part of the duties which the War Department Chemist made his own.

During the thirty-four years of his service in this official capacity Mr. ABEL has served upon a very large number of special War Department committees of more or less high importance. In 1855 he became a member of the Ordnance Committee, and subsequently, when the organisation of that Committee was changed, and became a small specially paid Committee, he was made an unpaid associate-member, and has remained so up to the present day. As a very active working member of several successive special Committees on explosive substances, he has been very largely concerned in the improvements which from time to time have been effected in gunpowder for artillery and small arms purposes. Entrusted with the task, in 1862, of examining into the results of Von Lenk's labours in attempting to apply gun-cotton to war purposes, Mr. ABEL'S researches led him, in the first instance, to devise an entirely novel system of manufacture and use of gun-cotton, whereby, on the one hand, its stability was placed upon a much higher level than before, and, on the other hand, its application, with thoroughly reliable efficiency and great safety, to every variety of military engineering operation, including its use in submarine mines and torpedoes, was secured, in consequence of which it has long been an indispensable service-explosive agent, not only in this Country but in other European nations.

As a member of a Special Committee on Floating and Submarine Obstruction at the time of the American War, and as a member of the Royal Engineer Committee, and of several successive Torpedo Committees, both of the War Office and the Admiralty, Mr. ABEL has been very largely concerned in the foundation of the present service system of defence of our harbours and rivers by submarine mines, &c., and as far back as 1856 he performed important work, conjointly with the late Sir Charles Wheatstone, on the application of electricity to the explosion of mines and guns, having subsequently devised electric fuzes and detonators of various kinds for service use.

In his capacity as scientific adviser to the War Office, the value of his services became so well known that he has been, from time to time, called upon to furnish, and has always zealously afforded, scientific advice and assistance to almost every department of the Government Service, including the Government of India and the Foreign Office. In response to requests from the Home Office he, some years ago, instituted laborious researches into questions relating to the safe employment of petroleum, one of the results of his work in this direction being the elaboration of the system of testing petroleum and mineral oils, whereby the legal test, known as the *Abel Test*, for petroleum now in use in this and many other Countries, was established.

In addition to the many important Committees which have had the advantage of Mr. ABEL'S co-operation, he has served upon the Royal Commissions on the Preservation of the Stone of the Houses of Parliament, on the Causes of Explosions and Spontaneous Combustion in coal-laden ships, on Noxious Vapours, and on Accidents in Mines, and, in connection with the latter, his experiments, extending over several years, on the relative merits of different safety-lamps, on the part played by Coal-dust in Mine-Explosions, and on the Safe Use of Explosives in Fiery Mines, have been especially valuable.

From 1857 till 1874 Mr. ABEL was continuously Examiner in Experimental Sciences to the Military Education Department, and had to deal with candidates for admission to the army, and the military and staff colleges, and with the students at those colleges.

Outside his official sphere Sir FREDERICK ABEL has always been active. He was for many years treasurer and afterwards president of the Chemical Society. He has also been president of the Institute of Chemistry, of the Society of Chemical Industry, and of the Institute of Electrical Engineers. In these and other official capacities he has delivered a number of addresses, and has also made many valuable scientific and technical communications to the more important professional societies on such subjects as the Constitution of Steel, the Metallurgy of Copper, and other metallurgical topics; the Development and Practical Applications of Explosive Agents; the Applications of Electricity to the Explosions of Mines and Guns, &c. He is an honorary member of the Institution of Civil Engineers (and Telford medallist); also of the Institution of Mechanical Engineers, the Royal Engineers' Institute, the Royal Artillery Institution, the Royal United Service Institution, the German Chemical Society, &c. He served three successive periods as chairman of the Society of Arts, and held the offices of member of Council and of executive committees, chairman of juries, &c., in connexion with the annual exhibitions held at South Kensington some years since, and with the recent series of special exhibitions (Health, Inventions, Colonial and Indian). In 1883 he was appointed by the Government one of the English Commission at the Vienna Electrical Exhibition, together with Lord Sudeley, Sir William Thomson, and Sir William Siemens.

He is a trustee and the chairman of the executive committee of the Athenæum Club. In 1884 he was made an honorary liveryman of the Goldsmiths' Company, and he is a member of the governing body and one of the most active men on the executive committee of the City and Guilds of London Institute for Technical Education, and is

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a governor of the Goldsmiths' Company's Polytechnic, now being established at New Cross.

Further, he is president-elect of the British Association, having already served repeatedly as member of Council and vice-president, and having delivered one of the Association lectures at the Edinburgh meeting in 1871. At the Royal Institution of Great Britain, of which he is a member of the Board of Management, he delivered in 1856 the first of a long series of Friday evening Discourses, which has extended to the present season. In 1888 he was appointed Rede lecturer at the University of Cambridge.

He was elected a fellow of the Royal Society in 1860, and has been a vice-president. To this society he communicated two series of *Researches on Gun Cotton*, which were published in the *Philosophical Transactions*, and in reference to which he delivered the Bakerian Lecture in 1867. Their publication was followed by an elaborate memoir, entitled *Contributions to the History of Explosive Agents*, also published in the *Philosophical Transactions*, and in 1877 the Royal Society Medal was awarded to him. He afterwards communicated to the Royal Society, jointly with Captain Andrew Noble, F.R.S., two memoirs, *On Fired Gunpowder*, giving the results, in part, of a series of important researches commenced about 1870, and continued up to the present time. He has also communicated a number of original papers to the Chemical Society and other scientific and professional societies, several of the former containing the results of joint work with the late Professor Bloxam, with whom he was joint author of the well-known *Manual of Chemistry*.

In 1888, after thirty-six years' service at Woolwich, Sir Frederick Abel was relieved of the duties of Chemist of the War Department, and was appointed President of a special Government Committee on Explosives, in which capacity he, in conjunction with his colleagues, Professor Dewar and Dr. A. Dupré, is now directing very important work connected with the Application of Smokeless Explosives to artillery and small arms.

In 1877 the Companionship of the Order of the Bath was conferred upon him, and in 1883 he was knighted at the same time as Sir William Siemens. He has also received the Honorary Degree of D.C.L. of Oxford and D.Sc. of Cambridge.

In 1887 Sir Frederick Abel accepted the post of organising secretary of the Imperial Institute, which was founded in the Jubilee Year of the Queen's reign, and in that capacity he delivered an address at the Royal Institution in 1887, before His Royal Highness the Prince of Wales, on *The Work of the Imperial Institute*, in which he foreshadowed a very wide field for the exercise of his activity and powers of organisation.

In conclusion: the labours of Sir Frederick Abel have been of immense value to his country; for the thoroughness of his scientific knowledge, the practical direction of his work, his careful attention to detail in all his researches and multifarious duties, his earnestness and activity in all he undertakes, and his wonderful power of organisation, together with his great tact and courtesy, have not only aided in a most marked degree towards the perfecting of the resources of our great military and naval establishments, but in numerous other directions have been of valuable service in directing scientific thought and action, and in organising other forms of useful work.

Provisional List of Geological Photographs,*

Arranged according to Counties.

Compiled by Osmund W. Jeffs, *(Secretary to the Committee on Geological Photographs).*

LIST No. I. Part II.

YORKSHIRE.

Yorkshire Geological and Polytechnic Society. Per James W. Davis, F.G.S., *Chevinedge, Halifax.*

Draughton, 1871	Contorted limestone.
Raygill Quarries, with Fissures, 1875	
Wadsley, 1876	Fossil trees in lower coal measures.
Moughton Fell, 1877	Junction of Silurian with mountain limestone.
Gordale Scar, 1878	
Plompton Rocks, 1879	
Raygill Fissure, 1880 (during exploration)	
Norber, 1881	Erratic blocks
Flamboro' Head, 1882	Erosion of chalk.
Scarboro' Castle, 1883	Nodular concretions in calc. grit.
Bempton Cliffs, 1885	Contorted chalk.
Clayton, 1886	Fossil tree.
Hilderthorpe, 1887	Cliff section.

(Size of each 11 inches by 8 inches.)

Leeds Geological Association.

Per S. A. Adamson, F.G.S., Secretary, *52, Wellclose Terrace, Leeds.*

Photographed by F. W. Branson, F.C.S., *14, Commercial Street, Leeds.*

Longley's Brick Works, Leeds	Coal Measures above "Beeston" bed of coal
Grosvenor's Brick Yard	"Beeston" bed (8 to 9 feet) and Coal Measures
Boyle's Quarry	General section, "Crow Coal," and Coal Measures above and below.
Do. Do.	do. do. (detailed).
Dolly Lane Brick Yard	"Black bed" coal, &c.
Benson Street Brick Yard	"Better bed" coal, &c.

[Note.—These were photographed in 1885, and were temporary sections, but extremely valuable as showing the succession in the Lower Coal Measures from above the Beeston bed to those immediately above the Elland flagstone.—S. A. A.]

Photographed by A. E. Nichols, *Borough Engineer's Office, Leeds.*

Haw Bank Quarry, Skipton, 1887	Carboniferous limestone, showing anticlinal.
Skibeden Quarry, near Skipton, 1887	Do. do.
Hambleton Quarry, near Ilkley, 1887	Do. do.
Cutting in Skipton and Ilkley Railway, 1887	Yoredale Shales.
Boulder of gritstone found in the "bind" or clayey shales overlying the Black bed coal, 1888.	Wortley, near Leeds.
Knaresborough, Castle Hill (foot of), 1888	Lower Magnesian limestone, resting unconformably on Plompton grits.
Knaresborough (below Abbey Plain), 1888	Do.
Do. (Quarry on river Nidd side), 1888	Lower Magnesian limestone.
Do. (Grimbald Crag), 1888	Do.
Do. (Plompton Rocks), 1888,	Third Grits of Millstone Grits Series.
Clayton, near Bradford, 1887	Fossil Tree (now in Owens College).
Garforth, near Leeds, 1889.	Brierland's quarry, Lower Magnesian limestone.
Do. do.	do. showing more detail.
Do. do.	Burlend's quarry, Lower Magnesian limestone.
Do. do.	do. showing structure in bedding.
South Milford do.	Quarry in Upper Magnesian limestone.
Do. do.	do. do. (detailed).
Brough, near Hull do.	Mill Hill Gravel Pit (Post Tertiary gravels).
Do. do.	Brough Gravel Pit do.

* *Continued from page 139.*

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Photographed by J. E. Bedford, F.G.S., *Clifton Villa, Cardigan Road, Headingley.*

Draughton, near Skipton
Anticlinals in mountain limestone, showing 2 sharp anti- and synclinals.
Norber, near Clapham ... Erratic blocks of Silurian grit, resting on limestone.
Armley, near Leeds
Railway cutting section showing contorted sandstones in coal measures.
Filey ... ... Cliffs of boulder clay.
Do. (The Brigg) ... ... Lower calc. grit.
Bridlington ... ... Boulder clay and fresh-water gravels in cliff.
Do. ... ... Gravel pit in cliff, showing cross bedding.

Per A. S. Reid, M.A. *Trinity College, Glenalmond, Perth.*
Photographed by Dr. E. S. Reid.

Draughton, near Skipton ... ... Contorted limestone.
Do. ... ... Do.
Bolton Abbey ... ... Faulted synclinal in limestone.

SCOTLAND.

Per R. McF. Muir, *35, Underwood, Paisley.*

Partick, near Glasgow ... Four views of fossil trees in Coal Measure sandstone at Whiteinch.

Per Ed. Ward, *249, Oxford Street, Manchester.*

Series of 17 ½-plate Views, illustrating the Geology of Mull, taken by Mr. P. F. Kendall, *31, Parkfield Street, Manchester.*

Salen Shore ... ... Dykes.
Do. ... ... Intrusive basalt.
Do. ... ... Columnar dyke.
Arches, Mull ... ... Columnar dyke, with tachylite.
Do. ... ... Columnar dyke.
Do. ... ... Cave above tide mark.
Do. ... ... Columnar dyke.
Do. ... ... Do.
Do. ... ... Do.
Do. ... ... Spheroidal weathering of Basalt.
Port Bean, Mul ... ... Faulted dyke.
Do. ... ... String dyke.
Gribun, Mull ... ... Cliffs and talus.
Carsaig ... ... Marine denudation.
Staffa ... ... Columnar basalt.
Do. ... ... Curved basaltic columns.

Presidential Address to the Liverpool Physical Society.*

By Professor Oliver Lodge, D.Sc., LL.D., F.R.S.

We meet here as a working society of members, all alike interested in physical science and willing to study seriously the enormous groups of phenomena which that term covers. Our subject is a most enticing one, but it is alarmingly huge. No man can pretend to be equally familiar with all parts of it, and with all its border sciences. Yet, to be a complete physicist, that is what is demanded. As the German proverb says, *Ein Physiker muss Alles kennen*, and the hopeless impossibility of satisfying such a demand ought to brace us to fresh effort rather than to unnerve us with slackened energies. Such a demand, moreover, has the happy equalising effect of the theological doctrine of original sin and free grace: it makes us all alike incompetent and unworthy; and since no man is able to proclaim himself a complete *Physicist*, every man who takes up and works at one corner of it may hope for some result from his labours, if he pursues them in a patient and candid and undogmatic spirit.

With those persons—paradoxers, as De Morgan called them—who, on the strength of a few ill-considered notions, propose to reconstruct the universe, and to flout their conceited ignorance in the face of the great searchers after truth of all eras: with them, I was going to say, we have no patience. But patience one does have with them nevertheless, for they are frequently unhappy and misguided men, not without a certain ability, possessors often of a very enviable energy; men who, if rightly self-directed, might have accomplished something, but who, by reason of some trivial crank, continue all their lives to batter themselves fruitlessly against the hard wall of opposing fact, flattering themselves that they are attacking a malicious combination of unprincipled scientists, banded together in league against them.

* Delivered at the Inaugural Meeting held on 16th December, 1889.

Such are the men who say that the earth is flat, that electricity and heat are identical, that water is a form of energy, that the circumference of a circle is commensurably related to the diameter, and so on. Men, again, who assert that they have discovered a new force, and that the nature of electricity has revealed itself to them, after reading some 3s. 6d. text-book on the subject.

Such persons should be informed that what they have found in an elementary text book is but the A B C of the subject, and for them to presume to have a first-hand opinion on it is as absurd as if a person who had read nothing but a few pages of English Grammar, should propound opinions on English literature, and write an essay on the works of (say) Mr. Browning.

Not such, however, are the men who ever advance science. The unprofessional workers are patient humble men, who grope their way, occasionally by means of mathematics, more often by means of experiment; searching diligently and recording their results, guided by instinct often more than by knowledge, knowing indeed it may be very little, and making many mistakes, but perseveringly amending their methods and devising fresh ingenuities of attack. To some of these it is occasionally given to discover secrets hidden from the wise and prudent.

A trained mechanician, for instance, has immense advantages in the command of tools and weapons of investigation. Such workers have often a deftess of hand, a keenness of eye, and a delicacy of touch, which those who have had more time and opportunity for study have good cause to envy. And their very lack of a wide outlook, by leaving them leisure and will to concentrate attention on one small corner of the field, may result in their detecting treasure unsuspected by the man of broader view.

Continually it has to be noticed that the most novel and surprising facts are discovered, not by the man of learning, who is apt to be overweighted by his stores of information and to move rather cumbrously in unexplored territory, but by the light skirmisher or adventurous explorer, who penetrates with apparently inadequate equipment into wilds and thickets regarded as scarcely penetrable by the more completely panoplied general of modern science.

In the region of the known there is no comparison. On civilised soil the batallions of von Moltke would sweep away a few hardy volunteers; but in the wilds of South Africa, or the upper stretches of the Nile, advantage not infrequently lies with the Zulu or Arab enthusiast.

Such guerilla warriors it is, I imagine, the business of this society to gradually discover and bring together, so as to aid each other as far as may be by mutual encouragement and occasional timely advice.

How many there may be of such workers, *in esse* or *in posse*, in and round Liverpool I have as yet no means of knowing.

Of microscopists, and astronomers, and workers in biology and its allied sciences, there is a fair supply; the workers in physics at present known to me are few. The interest shewn in the formation of this society, however, and the rapidity with which members have joined, are very encouraging facts, and I hope that we shall soon settle down to quiet and useful co-operation in physics, as well as in the other sciences so effectively represented by societies in this city.

As a beginning I propose, first of all, to bring forward a Classification of the Sciences with which I was rather pleased when it occurred to me some time back while walking down Prince's Road. I doubt not that it is very open to criticism, but there are some useful points in it as indicating the bearing of the main sciences on each other.

The idea running down the main trunk is that of "explanation." What do we mean when we say that a fact or phenomenon is "explained?" We never mean *ultimately* explained. To ultimately and completely explain the most seeming trivial fact demands, I expect, omniscience. No, we only mean carried one step from the more unknown to the less unknown. The derivation suggests carried one step from the rugged to

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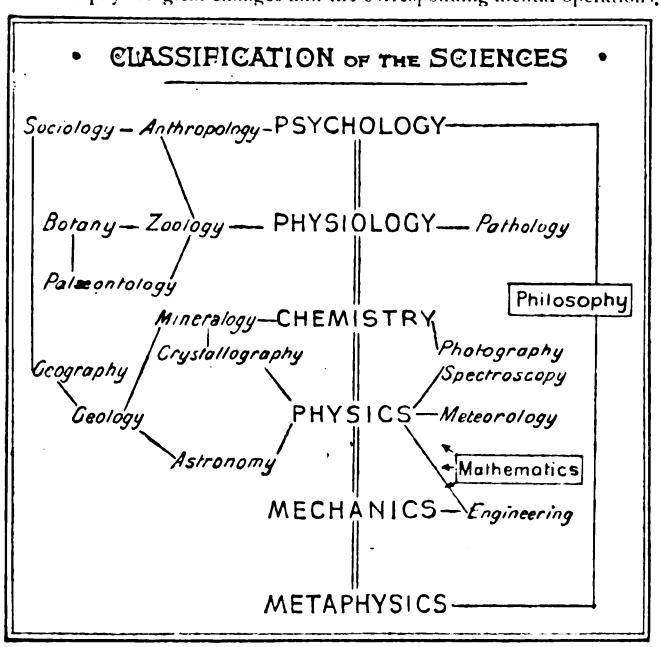
the smooth—flattened out, as it were; more precisely expressed, carried one step from the unfamiliar to the familiar. If we can relegate a puzzling fact to a category we have grown accustomed to we think we know something about it, and we say "it is explained."

Thus, for instance, Physics is explained by Mechanics. The aim of the Physicist is to reduce an obscure physical fact to simple mechanics, and when he has done this the fact is considered to be understood. So, also, the Chemist deals with phenomena which he seeks to explain by heat, electricity, dissociation, and the like. Any explanation of the force of chemical affinity, for instance, must be through Physics and Mechanics, hence we may say that Chemistry tends to be reduced to Physics as it becomes better known. Likewise, the science which I have called Physiology, but which might equally well be called Biology, except that the latter term is too wide, and embrace the whole upper group, as the old term Natural Philosophy embraced the whole lower group. This science of Physiology seeks to explain itself by help of Chemistry, and if the processes going on in brain and muscle and nerve in alimentation and secretion can be expressed in exact chemical language, they are, so far as physiology is concerned, explained. Lastly, the science of mind, or Psychology, whether the operations of thought are capable of being expressed in terms of brain processes, *i.e.*, of being reduced to Physiology, which is, at all events the present aim of Psychologists. The attempt may end in failure or in success, but the only way to find out how far anything can be done in that direction is to make the attempt; to experiment physiologically, to localise the functions of the brain, and to have all the hidden connexion between definite physiological changes and the corresponding mental operations.



To explain the fundamental facts of Mechanics is not an easy matter; such notions as force, matter, motion, and energy seem root-notions in themselves, incapable of being analysed or explained; but the attempt is made nevertheless, not indeed at present with very great success, and the attempt is called metaphysics.

Psychology and metaphysics are both the home of philosophers, and philosophy thus links matter and mind together.

Mathematics, or the great science of number, does not come into this chain of the science of *things*, but it throws out its arms and lends its powerful aid to such as are ready to receive it, notably to mechanics, to astronomy, and to physics. To chemistry before long, to other sciences in due time, as they get more advanced; but not yet.

Besides these great main sciences there are numerous branch, or dependent, sciences, linked up together by connecting nerves, somewhat in the way shown in the diagram. Each one as it grows throwing out feelers or suckers, and deriving fresh vigour and sustenance from one after another of apparently remote branches of knowledge.

The sciences most closely allied to physics are here plainly manifest. They are Mechanics, Chemistry, Astronomy, Crystallography, Meteorology; Mathematics, of course, as the great auxiliary science; and not far away are the half sciences, half arts of Engineering, Photography, Spectroscopy. Of all these a competent physicist should at least have a smattering.

Having now ridden my little hobby, I will see what useful suggestions I am able to make concerning fields of work lying open to the explorer at the present time. Needless to say that those I do not see or at the time think of are more numerous by far than those I mention, but, standing up and looking about, I see a number of likely-looking avenues which may lead to something if followed up; all that is needed being a good head, patient labour, and persevering skill to bring facts to light now only dim and unknown. Some of these avenues I will now do my best to point out; and though, no doubt, some are blind alleys if pushed into straight ahead, it is wonderful what side issues and unexpected openings present themselves when once you have set out on a quest. This is the great advantage of a study of nature. You may, by ill-luck, start with erroneous ideas, and may be aiming after something impossible to attain; but, if you keep your senses open by the way, the things you will unexpectedly hit upon turn out far more interesting and really valuable than the chimæra in quest of which you started.

It is a fact well known to workers that in looking for asses you may find a kingdom; and this fact cannot be too strongly impressed upon the young investigator, else he may be tempted to overlook side issues instead of probing them to the bottom as he comes upon them, and following them up if they seem to lead anywhere. Hundreds of them will be worth nothing, but if the hundred-and-first is a genuine clue he may think himself lucky.

Running over some of these open paths we come across a fruitful field in a study of the effects of light on a great number of things. That light affected chemical combinations has long been known, and it is the foundation of photography, but we now find there is scarcely anything which light does not affect. It affects selenium enormously, bringing down its electrical resistance to half or one-third what it is in the dark: it may affect other bodies in a similar way. It affects metals, charging them electrically in a curious way, especially such metals as zinc. It seems to disintegrate or evaporate surfaces long exposed to it. It affects the electric field, causing a short spark to occur much more easily in ultra-violet light than in the dark. And quite recently, by Mr. Shelford Bidwell, it has been found to affect the magnetism of an iron rod in a sensitive condition. Of none of these phenomena has the investigation more than begun.

Then, in the region of photography, there is a good deal to be done, not only in understanding the photographic process itself, but in photographing rays hitherto intractable. The photography of ultra-red rays a good way below the visible spectrum is, so far as I know, in the hands of Captain Abney, who discovered how to do it. But others should now take it up and develop it. Celestial photography, with plates sensitive to obscure rays, might reveal a number of unsuspected and invisible semi-cool worlds.

The electric spark has lately been a favourite subject for photography, and much good work may be done by obtaining judicious photographs of lightning on fixed and on moving plates. A double-nozzled camera, with two plates, one fixed, the other spinning rapidly on an axis perpendicular to its plane (kept spinning at an approximately slow speed, say by clockwork), so that the same flash is depicted on both plates simultaneously, would give much valuable information.

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For some flashes a very moderate speed of rotation, or even a waggling camera, suffices, but for others a speed of thirty revolutions a second gives an image apparently the same as if the plate were still.

What is known as the Hall-effect in various substances has not yet been exhaustively observed or measured. It has not even been observed as yet in insulators, though it ought, one would think, to be there; nor has its connexion with the Faraday effect, the rotation of the plane of polarisation of light by magnetism, been at all satisfactorily or finally made out. While its discrimination from, or assimilation to, certain known thermoelectric facts is at present hanging in suspense.

Perhaps, however, these matters are rather too difficult and complex to be suitable for mention under present circumstances.

A simpler and more qualitative research is the effect of magnetism on a number of things. For instance, on living organisms. A person in a magnetic field is not known to feel anything. Reichenbach thought he had found people who were optically sensitive to a magnet, so that they could see whether an electro-magnet is excited or not. It may be so, but subsequent observation has not gone to confirm it.

But, even if all persons are insensitive (by no means a likely conclusion without experimental proof), other animals may not be. Phosphorescent things—a glow-worm, or some of the luminous sea beasts of Dr. Heidman—may be fit subjects for experiment. How, again, does a gymnotus or electric eel behave in a powerful magnetic field? I can imagine a fine field for a Physicist to encamp on Puffin Island, under the auspices of the Biological Society, and bully some of the microscopic and other animals with electric and magnetic and optical appliances. Even if they declined to take any notice, the fact ought to be ascertained; but, if any of them were properly sensitive, development of the fact might be surprising.

Then, again, plants: sensitive and other muscular plants are well known to set up electric currents and to be under electric control; magnetism might be applied to plants also; and about their electric phenomena there is much more to work out.

Heaps of experiments on plants and on germinating seeds cou'd be made by an ingenious physical experimenter, and, though they might be more sluggish in their response than animals, some remarkable development might ensue. A change of physical surroundings in the course of a few generations might bring about noteworthy changes of structure.

Seeds growing under inverted circumstances as regards light have, I suppose, already been experimented on. I don't know. I am not familiar with the subject, and the biological suggestions I throw out are therefore vague.

But this I feel, that so long as the origin of life is wrapped in mystery, experiments on the simplest form of protoplasm—subjecting it to a variety of kinds of circumstances, electrical, magnetic, optical, thermal, mechanical, and chemical—may any day, though not perhaps for a few centuries yet, result in an astounding discovery, which will throw our present idea of evolution into the shade.

A number of experiments and observations can also be made on crystals and crystal formation by those who have suitable opportunities. The accidental formation of twin crystals, and the beautiful optical phenomena which develope themselves at the twinning surface, are matters of quite recent discovery, or, at least, of recent attention. So also is the perfectly astounding fact that a crystal, such as Iceland spar for instance, can be mechanically twinned or pushed over into its perverted form by the pressure of a knife, judiciously applied.

Effects of magnetism on chemical action have now been discovered, and it is known that a piece of magnetised iron is less easily attacked by an acid than ordinary iron, provided at least the iron is pointed so that its lines of force are very diverging, or its field rapidly varying. But many other facts remain to be ascertained in connection with these subjects.

The electrical properties of flame are only partially worked out, and their power of discharging static electrification has had fresh light thrown on it quite lately by some experiments of Worthington,

The study of phosphorescent substances is yet in its infancy. Why should not a phosphorescent substance give out a really useful amount of light? What is the process by which the glow-worm maintains so brilliant a speck of illumination?

Many amateurs possess an induction coil, having, indeed, often made it themselves. Approximately the same number of amateurs do not know what to do with it when made. They use it to illuminate vacuum tubes, which they buy at a shop, nicely coloured. Well, don't buy them, but make them, and omit the colours. Read the researches of Mr. Crookes, and other more recent investigations on the subject by Schuster, and Moulton, and E. Wiedemann, and others, and you will find in the electrical phenomena of high vacua an unlimited field for profitable experiment.

More than this: a whole continent of practically unexplored territory has just been opened by the discovery of Hertz that electro-magnetic waves in air can be easily produced and detected. Some may know and some may not know of these brilliant investigations into the propagation of electro-magnetic waves. To those who do not know I can give no idea in the course of this address. I am dealing with them in my evening course throughout next term. But anyone with an induction coil, an empty room, and some bits of metal can repeat many of them. And repetition of known experiments is the natural prelude to the discovery of new ones.

The Hertzian receiver is a microscopic spark gap. This serves, but it is by no means necessarily the best, as it is certainly not the most metrical method. Gregory has tried a kind of metallic thermometer with some success. In Germany, I hear a kind of bolometer or wire resistance thermometer has been successfully used. Quite lately, Fitzgerald writes me that a galvanometer in circuit with a simple wire makes these waves apparent. This will simplify their investigation very much.

That is always the way. Once a thing has been done, hundreds of ways of doing it turn up. For instance, the telephone. The transmission of speech by electricity seemed a mighty achievement, and so it was; but now, almost anything will transmit speech—a flower-pot full of cinders has been made to talk.

The great electro magnetic waves excited by any kind of electric discharge are now under easy control, and they can be reflected by mirrors, refracted by prisms, concentrated by lenses. They can be polarised and analysed. Diffraction and interference effect can be detected in them. Everything optical has its counterpart in this new region, for they are to all intent and purposes Light: as Clerk Maxwell predicted nearly a quarter of a century ago, from refined and abstract mathematical investigation.

The whole of this great field now lies open to the explorer, and only a few have entered it. Here and there a mathemetician, here and there an experimentalist, is at work upon it, but there is plenty of room, and every fact is of interest.

These electric waves have been obtained as long as 2,000 miles and as short as a foot; they can easily be lengthened, they cannot so easily be shortened. If shortened to the 10,000th of an inch they would affect the retina and be visible. At present they belong to the region of the infra-red. Whether they affect the human frame at all is unknown. Apparently they do not, but further experience may show that they do. Here also is a scope for observation.

This is a good era for the formation of a Physical Society. That there is no time like the present is true, and true always, but it has been doubly true in science during this nineteenth century.

Abused we have been; much of our work has been divorced from art and culture, and some of our works are hideous. The foghorns, with which we shall shortly frighten in the new year, are unspeakable; but, for better or worse, the nineteenth century has been the century of science.

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Never has there been such an increase in knowledge, in material achievement; never have so many secrets of nature been unveiled.

We inherit the fruits of all this labour, we live encompassed by it—by the evil as well as the good—the smoke-canopied, overcrowded, and squalid towns, as well as the bright and beautiful ideas which this century is responsible for; and it remains for us to enter the twentieth century not abandoning the good but doing our best to remedy some of the evil, and to hand on the, at present, rather smoky torch of science, burning the clearer and the brighter for our life and work.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between November 16th and December 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board:—

(*a*) Barometer	Highest (December 5th)	30·74	Inches.
,, ,,	Lowest (December 10th)	29·19	,,
,, ,,	Mean	30·166	,,
,, ,,	,, for 22 years November	29·862	,,
,, ,,	,, December	29·860	,,
Temperature	Highest (November 22nd)	57·9	Deg. F.
,,	Lowest (December 2nd)	27·8	,,
,,	Mean	40·5	,,
,,	,, for 22 years November	43·3	,,
,,	,, December	39·8	,,
,,	,, of Evaporation	38·6	,,
,,	,, for 22 years November	41·3	,,
,,	,, December	38·1	,,
(*b*) Rainfall	Amount	2·262	Inches.
,, ,,	,, Mean for 22 years November	2·826	,,
,, ,,	,, December	2·672	,,
,,	Number of Days on which Rain fell	14	
,,	Greatest fall in 24 Hours (November 22nd)	0·686	Inches.
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·2	
,,	,, ,, for 22 years November	6·7	
,,	,, ,, December	6·9	
(*c*) Wind	Velocity, Greatest (November 25th)	54	Miles.
,,	,, Least (December 4th)	1	,,
,,	,, Mean Hourly	16·2	,,
,,	Greatest Pressure on Square Foot (Nov. 26, 1·35 p.m.)	25·8	Pounds.
,,	Direction at time of Greatest Pressure	W	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
15	19	277	86	71	117	93	42	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed one foot above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

THE WEATHER.

November 15 to December 14, 1889.

The third week of November was remarkable for high barometrical readings—a persistent anticyclone extending over the whole of Western Europe—calm to light airs, overcast sky, and high temperature. A striking proof of the mildness of the autumn may be gathered from the fact that on the 19th I received a parcel of ripe raspberries, gathered on a fruit farm near Apply-bridge on the previous day; the fruit was near the normal size but of insipid flavour, owing to the absence of sunshine. The means for the week were:—Barometer 30·537 in.; corrected mean temperature 45·31°; relative humidity 92%. Totals:—Rainfall 0·165 in.; sunshine none; wind calm or Southerly. From the 22nd to the end of the month more varied weather occurred; the anticyclone passed away on the 23rd, succeeded by four days of irregular pressure, and a strong Westerly breeze on the 24th. A sudden change of temperature set in on the 25th; snow and hail fell on the 26th; the first frosty night of the season occurred on the 27th, when the mean temperature for the day was only 30·95°. During the last two days the barometer rose again, and on the 30th the temperature was about the average value. Means:—Barometer 29·986 in.; temperature 37·94°; humidity 89%. Totals:—Rainfall 0·798 in.; sunshine 15 hours 15 minutes; wind variable.

The means for the month of November were:—Barometer 30·183 in.—the highest monthly mean for upwards of three years; range 1·32 in.; 14 oscillations. Thermometers:—Temperature (corrected for daily range) 43·28°—about 7° above the average. Frost occurred on three nights. Relative humidity 92·2%—4% above the average. Amount of bright sunshine (Campbell-Stokes' recorder) 24 hours 55 minutes, or 10% of possible amount. Rain or snow fell on 18 days to a depth of 2·177 in.—about 1·3 in. below the average—bringing up the total from January 1st to 35·698 in. Slight thunder and lightning occurred on the 1st; hail on two days; hoar frost on three; fog on eight; and snow on two days.

During the first week of December the barometer was high, with a mean of 30·453 in.; the temperature low, ranging from 37° to 31·68°, with a mean of 34·54°; the atmosphere on the whole was decidedly drier, relative humidity being 79%. Snow and rain fell on the 6th, which when melted yielded 0·402 in.—the only precipitation of the week; of sunshine there was a solitary 5 minutes; wind Easterly or calm. During the second week both barometer and temperature were very unsettled, with rain, snow, graupel, fog, glazed frost, and bright sunshine sandwiched together. The means were:—Barometer 29·816 in.; temperature 37·11°; humidity 91%. Totals:—Rainfall 1·443 in. sunshine 6 hours 55 minutes; wind Westerly or calm.

W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, December 17, 1889.

Sheffield.

METEOROLOGICAL SUMMARY.

November, 1889.	TEMPERATURE. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	* Means for Nov. Daily Max.	Daily Min.	RAINFALL. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Nov.* Ins.
Sheffield ...	62°	7th	28°	28th	44°	—	—	0·71	9	0·24	1st	—
Spurn Head.	57°	7th	32°	27th	45°	—	—	0·35	12	0·10	26th	—
York	60°	10th	27°	13th	43°	48°	36°	0·73	13	0·19	14th	2·21
Barrow	53°	15th	31°	27th	45°	—	—	1·79	19	0·25	2nd	—
Liverpool ...	59°	7th	33°	13th	45°	48°	39°	2·45	17	0·69	22d	2·87
Holyhead ...	55°	22d	35°	27th	48°	50°	43°	2·93	17	0·62	24th	3·71
Oxford	59°	8th	28°	13th	44°	49°	38°	0·95	8	0·43	3rd	2·30
London	60°	15th	28°	27th	45°	50°	38°	0·75	9	0·24	24th	2·14

* The means of Temperature and Rainfall for November are for 15 years.

November 16 to December 15, 1889.

On November 16th pressure was high, the barometer ranging from 30·3 in. in the N. to 30·5 in. in the S., and it continued high till the 21st, when it was giving way, but readings were still above 30·0 in. The fall continued on the 22nd, but the barometer was rising again on the 23rd, and was above 30·0 in. It fell decidedly on the 24th, and was down to 29·4 in. in the N. and 30·0 in. in the S., the fall continuing on the 25th, with close isobars ranging from 29·2 in. to 29·8 in. On the 26th there was a gradual recovery of pressure, which continued on the 27th, and on the 28th the barometer readings exceeded 30·0 in., similar conditions prevailing on the 29th, but there was a brisk fall in the W. on the 30th. On December 1st the barometer was again rising, and the

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readings varied between 30·0 in. in the N.W. and 30·4 in. in the S.E., and there was a slight further increase of pressure on the 2nd, with little change on the 3rd and 4th. On the 5th the barometer was very high and even, the readings in most places being 30·6 in., this height being maintained on the 6th, with a tendency to give way. On the 7th pressure was down to 30·0 in., and was falling in the N. on the 8th, but rising in the S. It fell generally on the 9th, and was as low as 29·3 in. in the N. and 29·9 in. in the S., and fell very low on the 10th to 28·8 in. in the N. and 29·4 in. in the S., being still low on the 11th, though rising steadily. The rise continued in the S. on the 12th, but pressure was declining in the N., the fall extending to the S. on the 13th, but recovering in the N. The recovery extended to all places on the 14th, and the barometer was high and even, being between 30·1 in. and 30·2 in., the increase of pressure continuing on the 16th, when readings ranged from 30·1 in. in the N. to 30·4 in the S.

THE WEATHER.

During the week ending November 23rd the weather was mild, but foggy or hazy at many places. The early part of the week was dry, but towards the close rain set in, and the wind became strong in the West. There was rain on three days at Spurn, two at York, Barrow, Liverpool, and Oxford, and one at Sheffield, Holyhead, and London. The following week, from the 24th to the 30th, the weather in the first half was very cold, inclement, and unsettled, with showers of hail, sleet, or snow in nearly all parts of the kingdom, but it improved after the 27th, though it became colder, and sharp frosts were experienced. There was rain on six days at Holyhead, five at Spurn, four at York and Liverpool, three at Sheffield, Barrow, and London, and two at Oxford. In the week ending December 7th the weather was dry and frosty on the whole and the wind light, but at the end of the week the weather again became unsettled and boisterous, with rain and snow over England. The maximum temperature at Oxford on the 3rd did not exceed 30 degrees, and at night it fell to 21 degrees. There was rain or snow on five days at Spurn, four at York, three at London and Oxford, two at Sheffield, and one at Barrow, Liverpool, and Holyhead. The weather of the following week, from the 8th to the 14th, fluctuated considerably and temperature varied greatly, the thermometer at times being decidedly high for the time of the year, while at other times sharp frosts were experienced. The wind was occasionally strong, and heavy showers of rain or snow were interspersed with fine, bright intervals. There was rain on six days at Barrow and Holyhead, five at Sheffield, Spurn, Liverpool, and London, and four at York and Oxford.

SUN SPOTS.

The weather has prevented frequent solar observations during the month ending Dec. 15th, and spots on the sun's surface have been rare, the only one seen being a small spot near the western limb on Dec. 11th. This spot was not visible on the previous day, and had disappeared on Dec. 13th, so that it had but a brief existence.

The planet Saturn is now coming into a position favourable for observation. At the beginning of January it rises at 8·30 p.m., and two hours earlier by the end of the month. As the rings are now perceptibly closing the opportunity of observing the ring system should be utilised during the present opposition, for very little of it will be seen in small telescopes for some time after 1890. The other planets are all practically invisible. E. HOWARTH, F.R.A.S.

Museum and Observatory, Sheffield, Dec. 20, 1889.

Dinsmore Gas Process.

AT a meeting of the Society of Chemical Industry (Liverpool section), held December 4th, in the theatre of the Chemical Laboratories, University College, Liverpool, Dr. Hurter, chairman of the section, presiding, Mr. Isaac Carr, engineer of the Widnes Gas Works, read a paper on "The Dinsmore Process of the Manufacture of Coal Gas," in the course of which he said that the process had for its object the conversion of tar formed in the distillation of coal into permanent illuminating gas. This gas, being generated in conjunction with the ordinary coal gas, increased the quantity and quality of the production over that of the ordinary method of carbonising. With regard to the permanency of the gas after it was made, he was satisfied that it was equal to the ordinary gas in both its storing and travelling properties, as he had had the quality checked at a distance of a mile from the works without any diminution being apparent. In the earlier stages of the process he had many disappointing experiences. For a considerable time the working on a commercial scale was not a success, and not until the discovery of the fact that it was necessary to graduate the temperature of the duct were the results such as to offer much encouragement. Tests from various qualities of coal showed that all were capable, under the Dinsmore process, of yielding increased results—in quantity about ten per cent, and in quality about four to five candles. At Widnes in May last—the time for the renewal of the coal contracts—it was found that to have bought again coal and cannel of the quality used previously they would have had to pay 11s. 9d. per ton. It was thought for a time that they would have had to advance the price of gas, but a few tests of coal of common quality, some of which had never been previously used for gas-making, opened a way out of the difficulty, and his committee bought coal, the average price of which was 7s. 4½d. per ton delivered. They had now had some months' experience of the working of this coal, and he had drawn up comparative statements as to the results. Allowing 1s. per ton for the inferior quality of the coke, and also, among other things, interest on the additional capital outlay, and leaving out a sum of £528, which was a low estimate for increasing the quality of gas from eighteen to nineteen candles, he found that they would this year have an actual saving through the adoption of the process of £1,758, which was equal to 4·1d. per 1,000 cubic feet of gas sold. The value of the system to them, situated as they were so favourably for the manufacture and disposal of residual products, was to be found in its light-producing power, as it admitted of the use of coal of a lower quality than it had previously been deemed expedient to use. Amongst other authorities the theoretical and chemical parts of the subject had been inquired into by Professor Foster, London, who concluded his report in these terms:—"I am much impressed with the simplicity of Mr. Carr's method of working the process, and I have no doubt that the merits of the system are such as to warrant gas companies in giving it a trial." In the course of a discussion that followed, the president pointed out that the saving effected under the Dinsmore process lay in the almost entire saving of cannel coal, and the making of gas of good illuminating power out of ordinary coals without the use of cannel. Mr. George E. Davies, F.I.C., &c. (Manchester), pointed out that, in some respects, the process ran on similar lines to one he had patented in 1885, but there was this difference—that he had gasified tar products separately in order to find to which of them the extra illuminating power was due. The results he had obtained led him to separate the tar into three portions; the lighter, containing the carbolic acid and benzole being too valuable to turn into gas were sold, as also the pitch which gave only a non-illuminating gas, and the middle oils were converted into gas by first passing them through an empty red-hot retort. Mr. Davies congratulated Mr. Carr on the simplicity of his process, as it did away with the complication of a separate distillation, but at the same time he thought it was a purely financial question, and that, although it might pay to use the process in one locality, it might be an absolute loss in another. It was quite certain that a large amount of illuminating power was generated by passing tar vapour through a red-hot retort. In a discussion which ensued after his having read a paper before the London section of the society, the gas engineer of Nottingham, Mr. L. J. Wright, endeavoured to prove the absurdity of his (Mr. Davies') proposals, but he was of opinion that Mr. Wright had failed in so doing,

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and he therefore hoped that Mr. Carr would go on with his experiments and perfect the process, for which, at least, there is in some quarters a decided want. Mr. W. King, manager of the Liverpool Gas Works, said that they were very deeply indebted to Mr. Carr for having taken the matter up, and for having worked out the details, which he had presented in a much more practical shape now than could have been done in the first instance. He pointed out that a test may be very satisfactory from a chemical point of view, but in a practical direction the financial question was the crucial one. He looked with a great deal of interest upon the process, and he hoped he brought to it a very unbiassed mind, though if anything he was rather biassed in its favour. His directors were putting down special plant for the testing of many processes of inventors in connection with the manufacture of coal gas, and he might say that one of the first uses this would be put to would be to thoroughly test and examine the Dinsmore process. The Liverpool company, owing to the high illuminating power of the gas they burned, were the largest users of cannel in the world, and if the Dinsmore Company could introduce any system which would enable them to dispense with the use of cannel, they would be rendering a very great service indeed. Mr. W. P. Thompson, Mr. Glover (St. Helens), Dr. Naef, and Mr. Norman Tate also spoke.

Manchester Technical School.

THE annual distribution of prizes to the students of this school took place on November 28th. Mr. Oliver Heywood, president of the school, occupied the chair.

The report, read by Mr. J. H. Reynolds, stated that the results of the science examinations showed a gratifying advance upon those of the previous year, and exceeded those of the year 1886, which were the highest ever recorded in the history of the school. A comparative statement of the total number of certificates gained by the day and evening students in science in each grade of the examinations during the last four years showed 1,131 for the past year, against 955 for 1888, 998 for 1887, and 1,031 for 1886. Fifty-five students, having made 20 attendances, were entitled to 61 advanced prizes given by the Science and Art Department, as against 43 and 57 last year. Eighty-seven students in the evening science-classes having made at least 25 attendances, and obtained a first class in the elementary stage, had been awarded by the Council 101 book prizes, of the value of 5/-, as against 98 and 112 respectively last year. One of the students, Joseph Greaves, who was also a student at classes in Rochdale, had been awarded a National Scholarship, value £168, tenable at the Royal School of Mines, London, for three years. Another of the students, W. H. Atherton, had obtained a Whitworth Exhibition, value £50. L. F. Griffiths had obtained the Goldschmidt Studentship of £2 10s., awarded by the Union of Lancashire and Cheshire Institutes, for success in applied mechanics and machine drawing. The Heywood Local Exhibition, value £50, for one year, had been awarded to Thos. Kendrew, *vice* L. F. Griffiths, who was unable to avail himself of it, and he had entered upon his year's course of study at the Royal College of Science, Dublin. Cyrus Ainsworth, the holder of this Exhibition at Dublin for the year ending June, 1889, succeeded in obtaining a Royal Scholarship, being first on the list of candidates, of the value of £50 per annum for two years, and fees remitted. J. P. Wrapson, Heywood Local Exhibitioner 1886-7, having completed his course in Dublin and received his diploma in engineering and the associateship of the College, had been appointed teacher of mathematics in the Technical School, Manchester. Richard Chorley, also a former student of the school, and the holder of a Royal Exhibition, had also completed his collegiate course at Dublin, and received his diploma and the associateship. W. H. Cavendish, the holder of the Rumney Scholarship, had likewise completed the three years' course in engineering at the Owens College, and received the degree of B.Sc. in Engineering of Victoria University. T. Clarkson, a former evening student of the School, had been appointed Demonstrator in Metallurgy in King's College, London; and R. Stanfield, likewise an old evening student, had received the professorship of engineering at the Heriot Watt College, Edinburgh. The results of the examinations in second and third grade art showed an increase in the number of students participating in them, and maintained their satisfactory character in respect of quality as compared with former years. The results of the examination in elementary modelling, conducted by Captain Woolner, special inspector of the Science and Art Department, were as follows:—11 were placed in the first class and 9 in the second, as compared with 6 and 23 last year. The results of the advanced examinations in art for the past session showed a considerable increase in the number of students taking part in them, and also an improvement in the quality of the work done. Eighteen students had obtained 25 third-grade art prizes in the National Art Competition for designs, drawings, and models. Eight students had gained national book prizes, as against nine last year. One silver and three bronze medals had been gained by the students, as against two bronze medals last year. A free studentship for one year, of the value of £3, had been awarded to H. Penfold. Last year the number of free studentships was five. There had been an increase in the total number of students successfully passing the examinations of the City and Guilds of London Institute in technological subjects.

The prizes were distributed by Mr. Wm. Woodall, M.P., who also delivered an address on Technical Education, and, in speaking of the Technical Instruction Act, he described it as a "halting and imperfect measure," with all the bad elements of compromise in it. It failed in that which they who had given most attention to this subject had always regarded as essential. It did nothing to encourage practical teaching in the elementary stages. The Royal Commission strongly recommended that drawing should be made a compulsory subject in elementary schools, just as writing now was, and until that was done they at any rate would not be satisfied.

Isomers of Quinine.

ALTHOUGH the preparation of quinine by synthetical means has hitherto baffled the skill of the chemist, there can be little doubt that the researches of Kœnig and of Skraup are opening up methods of approach for the solution of the problem. Meanwhile it is not without interest to note that two basic isomers of the alkaloid have now been artificially prepared in the laboratory. A description of these was given at the last meeting of the Liverpool Section of the Society of Chemical Industry, by Dr. C. Kohn, of University College, Liverpool. The first was prepared by him some three years ago, and is described in the *Journal of the Chemical Society* (1886, p. 508). The substance is a complex derivative of quinoline, one of the constituents of the all-prolific coaltar, and, like many bodies obtained therefrom, it possesses physiological properties, to some extent akin to that of quinine. It acts as a weak antipyretic, and the fact that it is less active than kairin —also a quinoline derivative—is not without bearing on the constitution of quinine itself. The value of the artificial drug obtained from quinoline, as febrifuges, is restricted to non-intermittent fevers, whilst it is well known that quinine is specially active in cases of malaria and other intermittent fevers. This difference in physiological behaviour is very characteristic.

The second basic isomer of quinine is derived from a body called *Pinol*, recently obtained from turpentine oil by Wallach and Otto, of the University of Bonn. Although this body is much less closely related to quinine chemically than the above, one remarkable analogy is the fact that it is fluorescent. Nothing is known as yet regarding its physiological action. Of course one must keep clearly in mind that chance cases of isomerism such as these are entirely without bearing on chemical synthetics.

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Societies and their Work.

IN the endeavour to carry out their work on scientific principles, architects are frequently hampered not only by their clients but by public bodies and corporations. This fact was alluded to in the discussion which followed the reading of a recent paper before the Liverpool Architectural Society, by Dr. Damer Harrison, on "The Medical Aspects of Ventilation." Some of the speakers maintained that compulsory legislation was required to provide for the effective carrying out of ventilation, especially in respect to workmen's dwellings.

Speaking of "scale" in boilers at a recent meeting of the Yorkshire Engineering Society, Mr. Cuttriss introduced a description of an electrical method of prevention which was virtually an extension of the old plan of suspending zinc plates in the water. On account of the low electro-motive force of the zinc and iron combination this plan did not succeed well, but when assisted by a separate dynamo, giving a current strong enough to decompose water, the desired result is attained.

Conchology seems to have many devotees both in Lancashire and Yorkshire. At the November meeting of the Manchester Conchological Society, Messrs. S. P. Hardy and F. Collier exhibited some rare beetles found in our own country, and also in such far-off regions as South Africa and Ceylon. The Leeds conchologists, at their usual meeting on December 2nd, had for inspection a large collection of shells, amongst which the most remarkable were a series of *Limnea*, shown by by Mr. W. Nelson; *Ampullaria* (from Buenos Ayres), shown by Mr. T. Rogers, and a very complete collection of land shells of the district of Langharne, Carmarthenshire (a much neglected county), the work of Mr. G. W. Mellors, of Nottingham.

The "Urticating Hairs of Lepidopterous Larvæ" formed the subject of a well-illustrated paper by Mr. F. N. Pierce, read before the Lancashire and Cheshire Entomologieal Society at the last monthly meeeting. As most entomologists are aware, many hairy caterpillars, when too freely handled cause a rash to appear on the skin not unlike that resulting from the sting of a nettle, not only when the caterpillars are alive but also when they are dead, and particularly when the hairs are woven into the cocoon and protrude on the surface.

The newly-formed Physical Society in Liverpool commenced its work under favourable auspices. Ninety members were enrolled at the inaugural meeting, and an attendance of over 150 assembled to hear Professor O. J. Lodge's opening discourse, which will be found on another page of this issue.

A series of lectures on Geology and Biology has been in progress in connection with the Craven Naturalists' Association, the respective lecturers being the Rev. E. Jones and Mr. W. Wakefield, B.A. The members of this society evidently know the value of systematic work.

During the session of the Leeds Naturalists' Club and Scientific Association which has just concluded, no fewer than 38 thoroughly scientific meetings have been held, besides eight excursions and two marine-dredging expeditions. At recent meetings admirable papers were read by Dr. Lew Rowitsch on "Water," and by Mr. J. Stubbins, F.G.S., on "A Bee Parasite—*Stylops Spencii*." A remarkable instance was recorded of one bee having seven of these stylops—more parasite than bee!!

The Biological Society of Liverpool seem to have no lack of papers at each meeting. Indeed there is a plenitude at some of them, which necessitates a long sitting. The agenda of the December meeting contained no fewer than five items, and included the third annual report on the Puffin Island Biological Station, by Dr. Herdman.

Before the Liverpool Microscopical Society Mr. Wm. Narramore, F.L.S., read a paper giving the results of some interesting investigations on *Vaucheria and a Parasitic Rotifer on*. We hope to give this paper, with illustrations, in an early issue.

The Manchester Microscopical Society have held further demonstrations of methods of mounting, to which Messrs. E. Ward, J. Hart, and G. Wilks contributed useful information. The Field Naturalists of the same city have been turning their attention to Ecclesiastical Architecture, a subject which was descanted upon by Mr. A. Darbyshire, whilst upon another occasion Mr. William Gee discoursed upon the ever-attractive topic of the Town Geology of Manchester, with special reference to the Ship Canal. The causes of the high death rate of the Cottonopolitan capital were entered into at some length by Mr. W. Mounsey before the Scientific Students of Manchester, who, to show their versatility, have also occupied themselves with the examination of plant tissues under the microscope. "Plant Culture and Insect Pests" was the subject of a valuable and suggestive paper, read by Mr. H. Range before the Horticultural Society, also of Manchester.

The Yorkshire Naturalists' Union held their twenty-eighth annnal meeting at Hull, on November 20th, under the presidency of Dr. H. C. Sorby, F.R S. In the report (read by the Rev. E. P. Knubley, M.A.) it is stated that the total membership of the forty societies now amalgamated in the Union has now reached a total of 2,517, which with the direct membership of the Union makes its total numerical strength about 2,925. An invitation to hold the next annual meeting at Halifax was accepted. The presidential address was delivered in the evening by Mr. H. E. Dresser, F.L.S., who dwelt upon the progress of the study of natural history.

Two subjects of widely diverse interest have been discussed at recent meetings of the Leeds Geological Association. Mr. A. Farrar, F.G.S., contributed "Holiday Notes on the Cromer Forest Bed," in which the author gave an excellent account of this most curious fragment of pre-glacial history. Referring to the contortions in the chalk at Cromer, Mr. Farrar mentioned, among others, the theory advanced by Mr. Clement Reid, which attributed the contortions to the effects of land ice—a view adopted also by Professor James Geikie; but the author advocated caution in dealing with all these theories, on account of our (at present) limited knowledge of the effects accompanying a great ice-sheet over so comparatively level a country as East Anglia. The other paper to which reference is made is one by Mr. W. L. Carter, M.A., upon "Atmospheric Circulation," a slight, but useful, departure from the usual course of geological subjects.

Before the Wells Archæological and Natural History Society Dr. Livett gave an instructive paper on "Rocks," in which many of the problems in connection with the rocks of the Mendips and surrounding neighbourhood were lucidly explained. An account of the great volcanic eruption at Krakatoa, in 1883, was also given by the Rev. S. B. Peppin. The incidents and scientific features of this eruption, which will be regarded as a typical instance of a volcanic outburst for some time to come, were graphically rendered.

The duration of our coal supply is one of those questions which lend themselves to almost interminable discussion. It again cropped up at the December meeting of the Manchester Geological Society, when a communication was read by Professor Hull, who has been led to believe that the depth of 350 yards represents that from which the maximum quantity of coal is now being raised, and he advises an accurate statistical examination of the depth at which coal is being extracted, and the average rate at which that depth is increasing. Mr. J. Dickenson (chief inspector of mines) remarked that he had recently been down a mine to a depth of 900 yards, where the temperature was about 80 degrees, and that the only inconvenience he experienced was a peculiar feeling in the ears, whtch, however, soon passed away.

Mr. Ed. T. Ward gave the members of the Liverpool Engineering Society an account of the Salt Industries of Cheshire, which are just now exciting an unusual degree of attention.

At the Liverpool Geological Society's last meeting the principal item was a paper by Mr. T. Mellard Reade describing the ground traversed by the society on the occasion of their Easter excursion to the North Coast of Anglesea. Mr. O. W. Jeffs also read a paper, entitled "Photographic Records of the Rocks," illustrated by some fine exam-

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ples showing the value of the application of photography to the preservation of records of characteristic rock sections and other geological features. The Geological Association of the same city had an excellent address from Mr. W. Semmons, on "Some Recent Additions to British Mineralogy," followed by a descriptive account of the geology of Grinshill and Hawkstone Park, Salop, by Mr. Cecil F. Webb.

The annual *conversazione* of the Ealing Microscopical and Natural History Society was, this year, on a very large scale, and resulted in a most successful gathering, including the president of the society (the Rev. Professor Henslow) and about 400 guests. The long list of exhibits formed a goodly catalogue, and illustrated almost every department of science. Among the objects of interest exhibited by the president were some curious ancient books dealing with the sciences; a collection of ethnographical specimens from New Guinea; "freaks of nature in the floral world;" "musical sand;" and specimens of plants gathered by Darwin. Mr. J. Allen Brown also exhibited a fine collection of palæolithic flint implements. Many of the other objects displayed were in nowise less interesting, but space forbids further mention of them.

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National Conference on the Working of the Technical Instruction Act.—An important conference, convened by the National Association for Promoting Technical and Secondary Education, on the working of the Technical Instruction Act, 1889, was held in Manchester Town Hall, on Nov. 26th, the Mayor of Manchester (Mr. Alderman Mark) presiding at first and subsequently Mr. Wm. Rathbone. Representatives were present from many county, city, and town councils, school boards, science, art, and technical associations. Delegates were also present from the technical associations of Bristol, Cardiff, Leeds, Liverpool, Manchester, Nottingham, Oxford, Taunton, and Warrington, and from the National Education Association and the Macclesfield Chamber of Commerce. Sir Henry Roscoe read a statement by the secretaries of the association showing the progress made in the adoption of the Act, after which Mr. Edward Hance (Clerk to the Liverpool School Board) introduced a discussion on "The Relation of the Act to Public Elementary Schools." Following this there was a discussion, commenced by Mr. W. Mather, M.P., on "Modes of Adopting the Act," and at its conclusion Mr. Swire Smith read a paper on "The Apportionment of Grants," which was followed by one by Principal Garnett (Durham College of Science, Newcastle), on "The Best Mode of Re-organisation by which the Science and Art Department may meet the new duties imposed upon it by the Technical Instruction Act," in which he suggested that, subject to the consent of the executive council and the City and Guilds' Institute, the Science and Art Department should take over the City and Guilds' Institute, and from that as a working basis endeavour to form a national system of technical education. The following resolution, drafted by Principal Garnett, was moved by Sir Henry Roscoe:—"That, in the opinion of this meeting, Imperial grants should be made by the Science and Art Department in aid of the technological subjects now aided by the City and Guilds' Institute, the Government taking over that part of the work; and that the aid so given should be as little as possible based on the results of examinations, but should ultimately bear some distinct proportion to the contributions given by the local authorities, on condition of efficient management, equipments of the staff, &c., as tested by the inspection of inspectors of the Department." Mr. J. H. Reynolds (Manchester) seconded the resolution, but expressed a doubt as to whether it was wise to ask the meeting to make such a declaration at that point. Mr. A. H. Dyke Ackland, M.P., suggested that as there was probably some difference of opinion the resolution might be withdrawn for the present. This suggestion was acted upon, and after a vote of thanks to the Mayor and Mr. Rathbone for presiding the conference concluded. Its influence, however, in materially assisting in the adoption of the Act cannot fail to be very important.

Reports of Societies.

Biology and Natural History.

Birmingham Microscopists' and Naturalists' Union.—On November 18th the annual exhibition was held. The exhibits, which were very numerous, comprised a collection of local plants by Mr. J. Collins; the smaller fungi by Mr. Camm; land and fresh-water shells, with foreign varieties, and photographs of local scenery by Mr. J. Madison; minerals and coal measure fossils by Mr. Corbet; Silurian fossils by Mr. Lassetter; Eocene fossils, and butterflies and moths by Mr. P. T. Deakin; a large collection of Caddis cases, some of them built under special circumstances, also seaweeds and British, African, and New Zealand ferns by Mr. H. Hawkes; butterflies and moths by Mr. C. P. Neville; birds, including specimens of night-jar, heron, and snowy owls, the latter from North America, by Mr. J. Betteridge; British reptiles by Mr. F. Shrine; marine shells by Mr. Linton. In the centre of the room there was a large show of microscopes, under which many beautiful and interesting objects were shown. In the course of the evening the president, Professor Hillhouse, M.A., F.L.S., delivered a short address, in which he referred to the importance of developing the faculties nature had endowed us with, which were often less developed in us than similar ones in the lower animals, no studies being so advantageous for this purpose as natural science.——On November 25th Mr. J. Betteridge presented specimens of common heron and wheat-ear to the collection of the society. Mr. J. Collins then read a paper on "Filamentous Fresh-water Algæ." The writer gave a careful examination of these minute plants, their simple cellular structure demonstrating very beautifully the manner in which plants grow by cellular division. The various modes of reproduction, both sexual and asexual, were referred to at some length, special consideration being given to the very elaborate method of sexual reproduction. The *habitats* of the Algæ were mentioned as very variable, such as damp ground, stagnant ponds, clear streams, and cascades. The paper closed with an account of the important position these plants hold in the organic world as purifiers of water, &c. A number of specimens were shown under microscopes, and many drawings handed round.——On December 2nd Mr. T. H. Waller B.A., B.Sc., gave a description of rock sections he had presented to the society's cabinet, which had been specially chosen to show the different types of rock structure.

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Chester Society of Natural Science.—At the meeting of the Geological Section of this society on the 12th December, Mr. Osmund W. Jeffs read a paper, entitled "British Scenery in its Relation to Geological Structure," illustrated by a large series of photographic views shown in the lantern by Mr. W. H. Okell. Mr. W. Shone, F.G.S., occupied the chair. Mr. Jeffs, at the outset, indicated two methods of studying natural scenery—the æsthetic and the scientific methods. The latter was necessary in order to enable an answer to be given to the question: Whence comes the wonderful variety in the landscape features of the earth ever before our vision? On examining the earth's surface we find that the features which so much delight us are not permanent; on all sides we see evidences of the changes wrought by the ceaseless action of rain, rivers, the sea, frost and ice, and the atmosphere. What we term "scenery" depended on two great causes: firstly, the geological structure of a region, and, secondly, upon the character of the denuding forces to which it has been subjected, and which, acting upon rocks of varying hardness, have carved out the landscape into its varied outline of hill and valley. By means of photo-relief maps thrown upon the screen, the author contrasted the hilly and lowland districts of the country, showing how these features correspond with the rock structure as marked on geologically-coloured maps. Taking, first, the scenery of our coasts, a succession of photographs

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indicated the abrasive action of the sea in wearing away the land and forming caves, arches, and outlying pillars of rock. The history of streams and rivers was next traced from the simple rivulet to the foaming mountain torrent, and some striking views of river scenery were here exhibited. These were followed by some diagrams and photographs explanatory of the scenery of mountain districts. The origin of the great plain of Cheshire was briefly noticed, and, as showing the value of photography applied to geology, several pictures of geological features taken along the course of the Manchester Ship Canal were placed before the audience. An attempt is now being made to collect such photographic "records of the rocks" systematically, and have them placed in a permanent and central museum. At the Newcastle meeting of the British Association a committee was appointed for the purpose, under the chairmanship of Professor J. Geikie, F.R.S., and a provisional list of geological photographs has been issued, which includes several local views by members of the Chester Society of Natural Science and others. In conclusion, the author referred to the relation between the scenic structure of a region and its inhabitants. It was pointed out that the influence of natural scenery had deeply affected the art, poetry, and literature of our time. No hard and fast line could be drawn between art and science. To the artist the diversified features of hill and valley were instinct with beauty; but it was to the scientific observer that the history and origin of their development became fully apparent.

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NOTTINGHAM NATURALISTS' SOCIETY.—At the meeting held on December 10th Mr. J. Shipman, F.G.S., read a paper on "The Geology of Nottingham." He said that the geology of Nottingham was interesting on account of the variety of geological formations that rose to the surface within a very small area, and the evidence they contained of the physical conditions under which they had been formed. The geological record told not once, but several times, that the ground on which Nottingham stands had formed part of a vast lake or inland sea bottom, which had existed for long periods of time, during which the sediment that went to form sandrock and red clay was accumulated layer upon layer apparently quite as slowly as the sediment is accumulating at the present day at the bottom of the North Sea or the Lake of Geneva. The inland seas or lakes in which nearly all the local rocks were formed did not succeed one another without an interval between. They could not, of course, measure this interval in years, but they could form a rough idea how long it must have been by the amount of physical change—and the modifications in the animal and vegetable life of the earth—that took place in the meantime. In the neighbourhood, Mr. Shipman pointed out, there were not only sections showing how these formations rested on one another, but there were the remains of distinct beaches—the shore deposits of three separate inland seas or lakes that at different periods overspread the site of what is now Nottingham. One of these resembled the Dead Sea at the present day, and was a salt lake. Another interesting feature of the geology of Nottingham was the glacial drift. Nearly all the local drift deposits occurred on the west side of the town, and mostly along the sides of the Leen Valley. The glacial deposits in Nottingham were of three distinct ages. The oldest was the chalky gravel. Then came what was called the inter-glacial alluvium of the Trent, and the latest of all was the latter Pennine boulder clay, which was caused by glaciers that descended from the hills of Derbyshire, and crossed what was now Nottingham from the north-west towards the south-east.

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Geology.

GEOLOGICAL SOCIETY OF LONDON.—On November 20th the evening was chiefly devoted to papers of palæontological interest. Mr. R. Lydekker read a communication on the occurrence of the striped hyæna in the Tertiary of the Val d'Arno, and Dr. G. J. Hinde described a new genus of siliceous sponges from the Lower Calcareous Grit of Yorkshire, the exceptional character of which consists in their having the siliceous skeleton composed entirely of globates. A paper was also read by Mons. F. M. Corpi (communicated by Mr. W. H. Hudleston) on "The Catastrophe of Kantzorik, Armenia," which occurred on August 2nd, when part of the eastern mountain burst open, and the village, with 136 of its inhabitants, was buried in a muddy mass.—On December 4th, two communications from Mr. R. Lydekker were read, respectively on "Remains of Small Sauropodous Dinosaurs" and on "A Peculiar Hornlike Dinosaurian Bone," each from the Wealden. Mr. R. N. Worth gave the result of some researches into the igneous constituents of the Triassic Breccias and Conglomerates of South Devon, the author considering all the igneous materials to be of local origin. This paper gave rise to considerable discussion. Captain A. W. Stiffe contributed some "Notes on the Glaciation of Parts of Valleys of the Jhelam and Sind Rivers in the Himalaya Mountains of Kashmir," giving an account of his observations made in 1885, which appeared to him to indicate signs of former glacial action on an enormous scale.

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General Science, &c.

THE ROYAL SOCIETY, LONDON.—At the anniversary meeting, held at Burlington House, the president, Sir Gabriel Stokes, referred to the experiments made by the late Sir J. B. Lawes to discover the conditions which influenced the growth and yield of crops, and said that these experiments would be continued by a committee who would have the use of the laboratory and experimental grounds of Sir J. B. Lawes, and be assisted by a fund of £100,000, bequeathed by that gentleman. Among the officers elected for the year were Sir G G. Stokes, president, Dr. J. Evans, treasurer, and Professor Foster and Lord Rayleigh, secretaries. The usual dinner of the fellows and their friends was held in the evening.

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ROYAL INSTITUTION OF GREAT BRITAIN.—The annual course of Christmas lectures commenced on December 28th and 31st, and will be continued at three o'clock on the afternoons of January 2, 4, 7, and 9. The subject of the course this season (adapted, as is usual, to a juvenile auditory) is "Electricity," and it will be ably expounded by Professor A. W. Rücker, F.R.S. In addition to the above, the course of afternoon lectures before Easter includes ten lectures on "Before and After Darwin. Part III.—The Post-Darwinian Period," by Professor G. J. Romanes; three lectures by Mr. E. R. Mullins on "Sculpture in Relation to the Age;" three by the Rev. Canon Ainger on "Three Stages of Shakespeare's Art;" four by Mr. F. Niecks on "Early Developments of the Forms of Instrumental Music;" three lectures by Professor Flower on "The Natural History of the Horse and its Extinct and Existing Allies;" and seven by Lord Rayleigh on "Electricity and Magnetism." At the opening evening meeting of the session, to be held on January 24th, Professor Dewar will give a discourse on the "Scientific Work of Joule."

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LIVERPOOL AND DISTRICT SCIENCE AND ART TEACHERS' ASSOCIATION.—At a meeting of this association, held on Saturday, December 14th, the president (Mr. W. Hewitt, B Sc.) delivered his annual address. Speaking of the Technical Instruction Act he said it was satisfactory to find that at last some practical issue of the vast amount of discussion on the subject was possible. The Act, though not granting all that the most earnest advocates of technical education desired, still rendered much good work possible; and one of its most valuable features was the considerable amount of freedom which it placed in the hands of local authorities. In connection with the exclusion of elementary schools, as such, from the provisions of the bill, he pointed out that those who took the most limited view of technical

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education as that education only, which was designed to train a man for some particular employment or profession, agreed that such special instruction should be based upon a broad preliminary and general education, embracing elementary science, drawing, and some form of manual training. It was, therefore, very important to provide, by some means or other, that such a preliminary education should be given, if special technical education were to be a success. A plea was urged for the official recognition of the physical laboratory, and its importance as a training in practical science. Attention was also called to the scheme for a course of instruction in physical science recently published under the authority of a committee of the British Association. This scheme—and especially that part of it designated by Professor Armstrong, who framed it, "the problem stage"—was commended to the careful study of science teachers as illustrating in a practical manner the principles upon which science teaching as a method of education should be conducted, viz., to habituate the pupil to observe, to reason from his observations, and to check his results by further observations and experiments. In connection with Professor Flower's address to the British Association on the subject of museums, it was pointed out how museums might render valuable assistance to teachers of science and art in many ways. The educational value of the Liverpool Free Museum was commended, and it was urged that steps should be taken to form in connection with that institution a department illustrating commercial geography, and another illustrating local geology and natural history. After tea a social meeting was held, at which music, lantern views, and exhibition of apparatus made up an interesting and enjoyable programme.

LIVERPOOL ASSOCIATED SOIRÉE OF THE LITERARY, SCIENTIFIC, AND ART SOCIETIES.—The arrangements of this meeting are now complete, and in addition to the musical attractions of the Cymric Vocal Union, Liverpool Opera Society, and a large exhibition of scientific and art collections, the following illustrated lectures will be delivered, viz.:—"The Science of Animal Locomotion in its Relation to Design in Art," by Eadweard Muybridge, of the University of Pennsylvania, illustrated by the zoopraxiscope; "The Lancashire Witches in the Seventeenth Century," by Frank J. Leslie, F R.G.S.; "Lake Vyrnwy Waterworks," by Coard S. Pain, ex-president Engineering Society; "Roman Antiquities in Southern France," by Rev. H. J. Palmer, M.A.; and "Memorials of Spain Underthe Moors and the Christians," by James Birchall.

Letter to the Editor.

LIFE-ZONES.

SIR,—In the November number of *Research* there is an article on "The Life-Zones of the British Lias," in which the author attempts to explain the causation of the gradual succession and modification of organisms which occurred during that period. In so doing he raises the whole question of causation of organic modification, for if his explanation be correct, it is a principle applicable not only to the period under consideration, but admitting of very wide application indeed, and, therefore, his conclusions must be carefully considered. After speaking of the physical and palæontological division of the Lias into Upper, Middle, and Lower, he says there is further a sub-divlsion into "life-zones," which latter nowhere exhibit any line of demarcation. He then states that the deposition, or sedimentation of the Lias was slow, but very regular; and further that the "life zones" are not separated by intervals, the fauna of one zone passing insensibly into that of another. Again: that each zonal fauna has been developed (with one exception) from the preceding one by a process of modification. He then asks "what was the modificative agency?" and proceeds to answer it on the supposition that there is "some positive energy in living things, which, if uncontrolled and uninfluenced by externals, will produce progressive changes"—a supposition which might have been entertained in the days of Lamarck. The author further says that the answer to this question given by MM. Tate and Blake is simply a confession of ignorance, and he proceeds to throw light upon the question by assuming that there is "some positive energy in living things" which causes their modification.

It seems to me that a "confession of ignorance" is preferable to the assumption of a factor of causation which we do not even know to exist. Moreover, an hypothesis based upon such a vague metaphysical supposition does not seem necessary to explain the facts of the case. In seeking for an explanation of the gradual modification of successive faunas, under the conditions above mentioned as occurring during deposition of the Lias, surely it is necessary to take into consideration that very important factor, "natural selection," just as one would consider its relation to any other fauna, past or present. However uniform the characters now presented by the Lias, it is not credible to suppose that, even while any one zone of it was being deposited, the incident forces acting upon the organic forms then present could have been quite uniform; for, to suppose such a condition of things, we must assume that there was both in the organic and inorganic world a condition of perfect equilibrium, which implies that there was no migration of living forms from one area to another, which latter would obviously be in itself an important disturbing force. Without asking too much deference to authority, I may remark that anyone who maintains that organisms, left under uniform conditions for a sufficiently long period, will of themselves undergo progressive modification, does so in direct opposition to the expressed opinion of the greatest exponent of evolution, who says that time in itself can do nothing. Moreover, if organisms possess that inherent power ascribed to them by the author, why should certain forms, such as some of the Trilobites of Silurian seas, or the still more familar form of Blatta, have existed unchanged for very long periods of time? On such an hypothesis there seem to be only two possible explanations of this latter phenomenon—either that in such cases the environment kept changing in such a way as to exactly neutralise the inherent power which is supposed to cause progressive development; or that the "positive energy of living things" does not exist in all forms of life, which is drawing still further on the imagination. Even in the domains of nature which appear most tranquil, we are told by the physicists and chemists that incessant change is going on, and we also know how obscure and difficult of observation many of the very potent modifying changes are, even at the present time; *a fortiori*, therefore, how careful we must be in assuming that at any past period was the environment of life uniform. Therefore, anyone assuming that the inorganic and organic conditions can have remained uniform and fixed for prolonged periods must adduce very strong evidence in favour of such an assumption, for the facts seem to point to the conclusion that the conditions of life can never have remained long without change, in greater or less degree. If, then, we admit that during the Liassic, as during other periods, there was not a condition of equilibrium, but one of change—possibly, during that period, but small in degree—then the progressive development which occurred then as at other times is explicable on the theory of "natural selection" as expounded in the writings of Darwin and Wallace. No one can doubt but that during the Jurassic period, as during other periods, the number of organisms produced was infinitely more than could obtain the means of subsistence. If, then, we admit for a moment such an improbable thing as a uniform environment for a prolonged period, the organic forms then present would, through "survival of the fittest," become in time perfectly adapted to that uniform environment, and would remain so indefinitely. Doubtless, however, the surroundings of the Mollusca, Cephalopoda, and Saurians of that period underwent changes, however small, similar in kind to what we are familar with elsewhere; and that in all probability, the succession of organic forms during the Liassic period was chiefly dependent upon the operation of "natural selection" and not upon some inherent positive power of which we know nothing. It has been stated by at least one illustrious writer on biology that, though "natural selection" has been a factor of causation in organic evolution, it has not been the main factor, and that it could never have given rise to such important transitions as those from Acraniata to Craniata, or from Amphibia or Reptilia to Marsupials and Mammals; but that the main factor has been the power of "co-ordination and co-operation" acquired by certain forms. While admitting the power of "co-ordination and co-operation" to have been a very important factor, too much overlooked, at the same time if we admit, as it seems to be on all sides, that numerical increase in the organic world is vastly in excess of those that can possibly be maintained; then the introduction, at a certain stage of evolution, of the power of "co-ordination and co-operation"—and later subordination—as a factor of causation, only removes the sphere of operation of natural selection, from the individual to the co-operative societies of organisms. After all that has been written upon the causal factors of organic evolution, especially "natural selection," it seems rather anomalous for anyone to maintain that, if enough time be allowed, organisms possess an innate "positive energy," which would produce the progressive modification observed in the Lias, and by extension, that which has occurred in the transition from Protozoa to Primates.

J. COWPER.

Publications Received.

The Classes, Orders, &c., of the Animal Kingdom, by F. P. Pascoe (Taylor & Francis); *A Fossil Fish (Chondrosteus)*, by Montague Browne, F.Z.S., F.G.S. (Geo. Gibbons & Co., Leicester); *The Advertisers' Guardian*, by Louis Collins; *Yn Lioar Manninagh*, October; *Le Travail*, November. The following publications for December:—*Assure, Knowledge, Naturalists' Gazette, The Worker, The Optical Magic Lantern Journal and Photographic Enlarger, Selbourne Magazine, Naturalist, The Brewers' Journal, &c.*

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NOTICES.

Several Reports of Societies have been received so late that we are obliged to defer their publication.

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Hoar-Frost.

BY DR. MCPHERSON, F.R.S.E.

(Lecturer on Meteorology in the University of St. Andrews.)

A BLENDING of cheerfulness and dread greets one on a hoar-frosty morning in the valleys of Scotland. There, under the familiar name of *rime*, it is gladsome or fell according to the age or health of the observer. To children it is generally most beautiful in its pictures. The glass panes of the bedroom window are artistically touched by some fairy's brush in the transformation of ice-fern leaves. But to the delicate woman the embroidery means the trappings of her hearse; she shudders at the foreshadowings of death. To the healthy artisan, as he walks briskly on to his morning's work, the meadow is charming in its brilliant lustre as the deep red sun throws its coloured light on the crystal spears, as reminiscences of light that trimmed the stars. But to the old man it is dreary; his sepulchral cough tells of the deadliness of the exhalation. To the artist few things in nature are more like the production of nature's secret ministry, when the radiant dew has been seized by the fairy frost and made to bedeck with an inimitable grandeur the smallest details on the earth's face. But to the one out of health the scene is "killing;" he breathes what with searching tenacity and deadly rawness he feels is attacking his very vitals.

Two men have given a commendable study to the nature of hoar-frost. Most people notice the phenomenon in its beauty or its chill; but these two have done exemplary work in investigating its character. These men are Patrick Wilson and John Aitken. A century divides them. Yet, as from a distant point the observer beholds two ranges of mountains, all but coinciding, the further removed ridge being only made visible by a slightly different shade of colour—though between the two ranges a broad valley intervenes—so when the recorder of physical research, many years hence, looks back to sketch the landmarks of meteorology, he will see two colossal heads all but coinciding, only differing in the clear-cut features of the one near to him, though a hundred years of work lies between.

Professor Wilson, of Glasgow, in 1783, assiduously studied the nature of hoar-frost. During the most part of that winter the atmosphere was extremely liable to change from a serene to a foggy state. When sheets of brown paper or plates of metal were placed out at the Observatory, all began to attract hoar-frost as soon as they had time to cool down to the ordinary temperature of the air. He first formed the opinion that the excess of cold at the snow-surface had a constant relation to its power of attracting hoar-frost from the air. We have already referred to this in our paper on the "Radiation from Snow."

Next, Professor Wilson placed on a circular board a quantity of flinty sand, half-an-inch in depth, and exposed it to the cold for four hours. He observed that the hoar-frost crusted the thermometers which lay on the sand and snow quicker than the thermometer suspended in the air. And—most wonderful of all—he found that, on weighing the board and sand, they had gained some grains.

With exemplary ingenuity and perserverance the Professor conducted his observations with many other substances, and he came to the conclusion that, when bodies attract hoar-frost from the air, there is a cold produced at their surfaces; that this cold does not originate from

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any peculiar qualities of bodies upon which the hoar-frost settles; and that the disposition of the air of thus parting with the hoar-frost has a constant dependence upon the general serenity of the atmosphere.

According to Mr. Aitken, whose account of the formation of dew—detailed in our columns—has now been received as the only true explanation by the best meteorologists of this and other countries, frost seizes the exhaling water-vapour from the earth and nips it into "rime." Hoar-frost is frozen dew. He observed that a sheet of glass exposed horizontally near the ground on a dewy night was frequently dry on the windward side. This showed that the air was not cooled to the dew-point, but had to travel some space over the cold surface before being cooled down to part with its moisture. When the same sheet of glass was presented on a very cold night, he saw it covered with hoar-frost up to the windward edge where the deposit was heaviest. This peculiarity in the deposit of hoar frost may be easily verified on branches, fences, and walls; in these the heaviest deposits will be found on the windward edge. Now, why is it that in the case of dew the heaviest deposit is *not* near the windward side, and in the case of hoar-frost the heaviest deposit is on the windward side?

In the formation of dew the air is not at first saturated, whereas in the case of frost it is super-saturated. In the former case there is always enough dust in the air to present *free-surfaces* for the attraction of superfluous moisture, whereas in the latter case things are quite different. It has been demonstrated that under certain pressures unfrozen water may be of a lower temperature than ice. Accordingly, if a water-surface and an ice-surface, at the same temperature, be placed near each other, vapour will tend to pass from the water to the ice. The air thus saturated to a water-surface is super-saturated to an ice-surface. That accounts for the difference in the formation of dew and hoar-frost. When the air is cooled, condensation takes place on the free-surfaces of dust, resulting in the fog, which before could not be easily accounted for. This moisture in the fog only seems—under certain conditions—to be liquid, for there is no indication of the particles being frozen. Yet the temperature of that fog—so dreaded in winter—is *below* the freezing point. But the moisture of the fog-particles is not solid. Water-particles float in the air during frosty and foggy weather, and the pressure of the vapour in the air will correspond to that of a liquid surface; it will be greater, therefore, than an ice-surface at the same temperature. Under these conditions the air will rapidly unburden itself of part of its vapour when it comes in contact with an ice-surface. That is why the hoar-frost grows in the direction from which the air is moving. The air, being then in a sense super-saturated, unburdens itself on the first ice-surface with which it comes in contact; whereas, when the dew is forming, the air frequently requires to travel some distance over the radiating surface before it is cooled sufficiently to give up its vapour.

As the result of many personal observations, and the observations of many careful scientists, Mr. Aitken is of opinion that there is never a heavy deposit of hoar-frost when the sky is clear, or in those conditions in which dew is most easily deposited. He has observed that on all those occasions on which trees and every exposed surface became clothed with silvery robes, and all nature became changed as if by elfin workmanship to a wondrous scene, the remarkable change seemed to be always accomplished in a foggy atmosphere, which required the morning sun to dissolve the veil and disclose the grandeur. In absolutely clear nights dew will bedeck the meadows in a glistening film; but in foggy nights, at a low temperature, hoar-frost will adorn the valleys with sparkling crystals, and seek into the sleeping chamber of the delicate sufferer. And further, while dew requires that the surface on which it is deposited be cooled by radiation, this may be absent in the formation of hoar-frost, because the fog-particles radiate and cool the air to the saturated temperature of vapour at a water-surface. Not only are those nights on which hoar-frost is most abundant not similar to the nights on which heavy dews are formed, but they are generally nights on which there would be no dew at all.

Summer fogs and winter fogs are, therefore, of a different constitution. In the summer the grey fogs are produced by the deposit of water-vapour upon the fine dust-particles which form the necessary free surfaces; but in the winter the moisture in the leaden fogs is colder than the freezing point. The "rotten rime" then is intensely killing. One thinks he is simply out in a fog, breathing moisture above 32° Fahr., when he may be breathing moisture many degrees below freezing. This it is which in Scotland is so deadly to man and beast. Every breath is a frost-laden sword-thrust to the decaying lungs. Beautiful is hoar frost in many of its forms, as in the early morning when the full clear moon shines through the window of a close carriage and discloses the marvellous spectrum-colours on the glass, according to the thickness of the films; but it is on the whole a scourge to vegetation and animal life.

Ship Railways.

By Richard Holland.

A SHIP railway is simply a scheme to carry greater burdens than have been carried hitherto on ordinary railroads. Bold and striking as the idea is, the principle was not unknown to the ancients, and history furnishes us with many striking examples of vessels being conveyed with their cargoes overland from sea to sea, either to avoid a dangerous and lengthy sea voyage or to effect some important strategic operation. The distance from Corinth to Athens by land is less than 50 miles; the journey round the Morea measures some 500. The ancient Greeks, dreading the long voyage through a sea thickly studded with rocks and islets, and fully realising the practical value of the Euclidean truth that a straight line is the shortest distance between two points, constructed, 550 B.C., a porterage for vessels from the Gulf of Corinth to the Gulf of Egina. The Dioclus, as it was styled, was of polished granite, along which the transit of vessels and their cargoes was effected by means of rollers. This method of transhipment continued for something like 300 years. In this, the first authentic instance of ship railways, the vessels, which were then square rigged, were accustomed to spread their lateen sails when the wind was favourable, thus affording considerable assistance to the oxen which were employed to draw them over the smooth granite track. Perhaps the greatest triumph which the ship railway achieved during the mediæval ages was that of Sorbolo. This engineer was in the service of the Venetians during their wars with the Milanese, and he formed the bold project of conveying overland a Venetian fleet to Lake Garda to oppose a powerful navy of the Milanese, who were then closely investing the city of Brescia. Mad as was Sorbolo's scheme at first deemed he was allowed to try it, and he ultimately proved that it was not only feasible but practicable, and six first-class galleys, each manned with 300 men and loaded with munitions of war, were enabled to make the journey in safety, and, to the utter amazement of their opponents, to successfully launch themselves upon the waters of Lake Garda. Sorbolo's achievement was all the more conspicuous as directly in his path lay the mountain of Peneda, but even this obstacle he successfully surmounted, and accomplished the descent to the shores of Lake Garda some three months after leaving Venice.

The ship railway of to-day, though striving to attain the same object as that of the ancients, viz., safe and speedy over-land transit for vessels, differs in two important respects. First, the burdens to be borne in transit are incomparably greater; and, secondly, and as an offset to this, is the fact that we can employ steam as the haulage power instead of the oxen utilized by the ancients. The shortening of sea voyages, and the consequent curtailment of expenditure per voyage, is a desideratum as ardently aimed at by modern engineers as was ever the philosopher's stone by the alchemist. Probably the ship railway will

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ere long become a very considerable factor in bringing about this desired result. A glance at the map of the world will show that regarding Europe as the great central focus of food-stuffs, and raw manufacturing material, two great natural obstacles to a speedy centralisation of this material oppose themselves in the shape of the continents of South America and Africa, respectively. The latter of these barriers to easy maritime intercourse has been obviated by the Suez Canal, and it was thought that the Panama Canal would have superseded and rendered unnecessary the tedious and dangerous passage round Cape Horn, the only direct connection between the Atlantic and the Pacific. Unfortunately, however, an unhealthy climate and unforseen engineering and financial difficulties have placed the Panama Canal scheme amongst the gigantic failures of the world, and we must look to other sources than that of a ship canal to supply the missing link in the line of a safe and speedy trade-route between the Atlantic and the Pacific.

A proposed ship railway is now in course of construction across the isthmus of Tehuantepec, Guatemala, a length of 130 miles. This scheme has commanded the marked attention of the United States Government, and their sanction has been given to the enterprise, as has also that of the Government of Mexico, who, by subsidies and land grants, are endeavouring to bring the scheme to a successful issue. The distinctive features of this ship railway, according to the designs of the engineer, Captain Eads, are that the car containing the vessel is to have a rigid wheel-base extending the whole length of the ship, and that the car is to cover six parallel tracks of 4 ft. 8½ in. gauge, with six feet ways between. The wheels are mounted on longitudinal and cross girders, with spiral springs interposed. A car 450 feet long containing 180 groups of four wheels, three feet diameter, would carry a dead weight of 6,000 tons, thus giving a weight of 8⅓ tons to be borne by each wheel. The ships were to be docked on a car seated on a submerged pontoon, sunk or raised by pumping the water into or out of it, while the weight of the ship was uniformly distributed over the keel and bilges by inter-communicating hydraulic rams. Changes of direction are provided for by a floating turn-table, which consists of a pontoon turning on a central pivot in a circular well, first grounded for the reception of the car and then pumped out to floating point for turning.

CHIGNECTO SHIP RAILWAY.

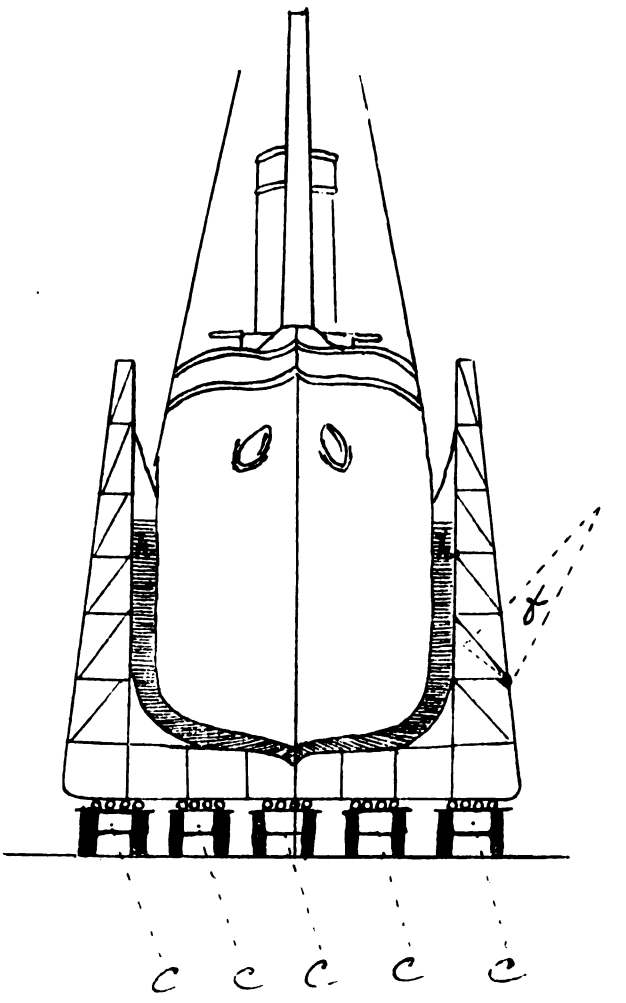
Sir John Fowler and Mr. Baker, the joint engineers for the Forth Bridge, are at present engaged, along with a Canadian engineer, in constructing a ship railway from the Bay of Fundy to the Gulf of the St. Lawrence, a distance of 17 miles. This, the Chignecto Railway, will no doubt be completed by September, 1890, and then the novel sight of ships of 2,000 tons burthen and downwards voyaging across the land will be witnessed. This scheme, while practically on the same principle as the Tehuantepec Railway, yet shows that scientific engineering as applied to ship railways is undergoing rapid development. This railway is perfectly straight, and is laid with two pairs of 110-lb. steel rails, 4 ft. 8 in. gauge, placed 16 feet apart. The rails rest upon sleepers 14 in. by 7 in., close placed, and the greatest gradient is 1 in 500. At the two ends of the line vessels up to 2,000 tons will be raised 40 feet on 16 wheeled trucks, resting upon enormously powerful hydraulic lifts. This is, so far, a development of Captain Eads' scheme, inasmuch as it shows a smaller wheel base, while his slow-working pontoons are superseded by quick-acting hydraulic lifts. The car proposed, however, is like that of the former scheme, to have a rigid wheel base and to be inflexible vertically.

The great difficulties to be encountered in the construction of ship railways are two.

I. The change of gradient.

II. The curves which a line of rails would have to make consequent upon any direction being necessary beyond that of a straight line.

At its present state of development a ship railway can only be made through a country specially adapted for it; for, so long as the wheel base of the ship-bearing car is rigid, it follows that a deflection either vertical or lateral is absolutely impossible. Hence the necessity of the elaborate and expensive turn tables of the Tehuantepec Railway, or the double line for ships travelling in opposite directions. An invention, however, is just announced which will, if it comes up to the sanguine hopes of its promulgator, Mr. Smith, M.Inst.C.E., harbour engineer of Aberdeen, completely revolutionize the ship railway of the future. He proposes, by means of an arrangement of hydraulic cushions or tubes which shall pass under the keel and up the sides of the



SMITH'S PLAN.

h h—Section of hydraulic cushion *f*—Folding side of car, which opens to admit vessel. *c c c c c*—Compound bogies.

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ship, to provide for the transit of the vessel in the car with a perfect minimum of risk. No matter what the jolting may be, contact between the ship and the sides and bottom of the car is prevented by the water cushions. But this is not the only benefit to accrue from Mr. Smith's invention. He proposes to form the bottom of his car a flexible platform resting upon trains of trucks, called compound bogies. The car links the trucks together, at the same time leaving them free to bend laterally round the railway curves, guided by wheel flanges. As the platform is constructed in segments hinged together, so as to admit of vertical movement, the difficulty of the inflexibility of the ship when adapting itself to a new gradient is compensated for by the hydraulic cushions rising and falling in the water, like a simple wave running along the tubes as the vessel changed gradients, similar to the passage of a ship across a smooth swell at sea.

Visitors to the Edinburgh Electrical Exhibition, 1890 will have a chance of witnessing for themselves the practical embodiment of Mr. Smith's scheme. The site of the ship railway, which will form one of the distinctive features of the exhibition, is to occupy a triangular piece of ground lying along the south bank of the Union Canal, and in its course there will be several gradients and curves. The railway is to consist of two parallel lines, each 20 in. gauge, with 3½ feet between each line of rails. The rails are to be 16 lbs. weight per lineal yard, laid on timber sleepers, and fish-plated. The inequalities of the ground will be made up of timber piles and trestles, forming a viaduct over some low-lying ground. There will be a passing-place at the middle of the line. The boats employed will be launches some 30 feet by 2 feet draught, and capable of accommodating some 30 passengers. Two flexible ship cars, formed as described above, will run simultaneously in opposite directions, drawn by a stationary engine and a wire rope. The cars will run down the slipways in the bed of the Union Canal until the boat reaches the depth in the canal at which it floats. One side of the car will then be unfastened, and the segments composing it being hinged to the bottom of the car open outwards, leaving the boat free to pass into the canal. The method of loading the car with a vessel is the reverse of this proceeding, the boat settling down on the hydraulic cushions as the car is drawn up the incline out of the water.

The true value of the latest phase of scientific research as applied to ship railways remains to be proved by practical experience. During the past few years the ship canals proposed for construction have been legion, but of them all, one, the Amsterdam Ship Canal, is an accomplished fact, while another, the Manchester Ship Canal, is in course of construction. The estimated cost of the latter is £200,000 per mile, and in all probability that estimate will be exceeded. A ship railway along the same route, and encountering the same difficulties of gradient, would cost, it is urged, something like from £60,000 to £80,000 per mile. A theoretical comparison of the working expenses of ship railways and ship canals would certainly seem to be more favourable to the former. The cost of towage on land by locomotive is less per ton per mile than the cost of propulsion by steam at sea. The resistance to the passage of a vessel through the water is due partly to the friction of the fluid on the skin of the ship, and partly to the fluid friction caused by the displacement of the water. Now, the expert votaries of the ship railway maintain that the rolling resistance of the wheels, combined with the friction on the axles of the ship railway car, can absorb very much less power than the fluid and frictional resistance to the ship in the water. The rate of progress, too, made by a ship along a canal must necessarily be slow, and this materially enhances the wage cost for the voyage. A ship railway, it is maintained, would considerably minimise the time occupied in making the journey from the sea to the desired destination, and would, in addition, require less hands to look after the transit of the ship. On the best American railways the cost per ton per mile is ¼d., on the Continent the charges average ½d., while on English railways the minimum rate is 1d. per ton per mile. On the Suez Canal the charge is 1d. per ton for vessels using their own propelling power, with additions for haulage and towage. On the English canals the working expenses of barges from 30 to 100 tons only is ⅜d. per mile. Against these figures, it is urged that with ships of 4,000 tons burthen the cost of haulage by ship railway would be less than 1-100th part of a penny per mile. Certainly, if ship railways achieve but a fraction of the results claimed for them by their promoters, we may expect at no very distant date to see inland towns abrogating to themselves the privileges heretofore the special attributes of seaports, and the ship railway bearing its ship burdens may become as familiar a feature of an English landscape as the railway train is now.

It is interesting to note about this subject that so far back as 1873 Sir John Fowler was invited by the then Khedive of Egypt to prepare plans for a scheme to enable steamers and other vessels to avoid that insuperable barrier to the exploration of the Nile from mouth to source, viz., the First Cataract. After careful study and investigation Sir John pronounced in favour of a ship railway, and it was only the chronic congested state of Egyptian finance that prevented the project from being carried out. Perhaps now that such an impetus has been given to the exploration of Central Africa the scheme may be renewed, and we may yet have the only natural communication between the civilization of the North African littoral and the Equatorial regions rendered, by means of the ship railway, an easy path to the very heart of the Dark Continent.

Do the Poles Change their Position?

By A. G. Nathorst.
(Director Geological Survey of Sweden, &c.)

THERE are hardly any features on earth which demonstrate more the uncertainty of the present climatic conditions than the circumstance that the Arctic regions, now covered with ice and snow, were once so favoured climatologically as to produce a tropical and subtropical vegetation, and although the climate after the Cretaceous period appears to have become colder and colder by degrees, it was still in the Tertiary period (Miocene) so warm that Spitzbergen was covered with forests, composed principally of maple, lime, magnolia, oak, hazel, beech, poplar, deciduous cypress, seguoia, &c. From this circumstance we naturally, first, come to the conclusion that the climate of the earth at an earlier period not only was warmer than at present, but more uniform in different latitudes. But no satisfactory explanation of the cause of this change has yet been forthcoming. At one time certainly it was assumed that this change was due to the circumstance that the interior heat of the earth in earlier geological epochs exercised an influence upon the temperature of the surface, whereby the problem referred to obtained a very simple explanation. However, latter-day researches have shown this theory to be erroneous. Without touching upon the physical side of the question, I shall only mention here that, if this was the cause of the warm climate of the Tertiary period, the temperature in the Carboniferous period must have been so high that neither animals nor plants could exist on earth, but we know for a fact that there was a richly-developed animal and plant life millions of years before that epoch. For this and certain other reasons it is now generally considered that the internal heat of the earth from the period of the earliest organisms appearing upon it has not exercised any noteworthy influence upon the climate. Other attempts at explanation have neither fared better, and the impartial student is, therefore, compelled to confess that the problem is still unsolved.

In advancing this theory its promoters had started with the assumption that the climate in the Tertiary period was warmer in high latitudes than now. But that is by no means certain, as, for example, we do not know, say as regards Spitzbergen, that the island was then situated in its present latitude. It might not then have been situated that distance

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from the Pole, in other words, we do not know *whether the North Pole of the Tertiary period is identical with the present.* That this was probably not the case has been expressed from time to time, but the probability was excluded at once by the situation of the Tertiary fossil deposits around it. Houghton's drastic expression was particularly vaunted upon this point, viz., "that the Pole was surrounded with such a row of fossil deposits that it could no more get outside it than a rat surrounded by dogs." However, *this view is erroneous.* The circle is not so complete as assumed by Houghton.

But before we return to this point we must refer to the opinion of the astronomers upon the possibily of a *change having taken place in the position of the Poles.* If no enormous transfer of matter upon the earth had taken place, the change should naturally be sought in ultra-terrestrial causes. But it is a fact that enormous shiftings of matter *have* and *are* taking place upon the earth in course of time. The division of land and sea suffers radical changes. The rivers transport enormous masses of *débris* from the continents to the oceans. For instance, in the Mississippi delta 200 million cubic metres of solid matter are deposited annually. The volcanoes, too, convey enormous masses of lava and ashes from the interior to the surface of the earth. Some of these transfers may, in many cases, be counterbalanced by others, but, in some instances, it is not improbable that *they might combine, and thus cause the shifting of Poles.* That such may be the case has been shown by many astronomers. Professor Gyldén, our Astronomer Royal, has, for instance, among others, maintained that "it was quite possible to realise such a change of continental and ocean valleys within the limits of their present polar differentials, that the present momentum of the earth's body, both as regards force end direction, might be changed, whereby a change might again be caused in the situation of the earth's axis." We all know that great changes without doubt occur upon our earth, and these changes *must* have some effect upon the position of the earth's axis. The question is really: How much?

Now we know with certainty that just after the middle of the Tertiary period very considerable changes have taken place upon the earth's surface. The most gigantic mountain chains of the globe, stretching from Terra del Fuego to Alaska, their continuation along Eastern Asia, the Himalayas, the Caucasus, the Alps, the Pyrenees were all formed *after* the epoch named, and the same is also the case with the enormous basaltic deposits covering Iceland, the Færö Islands, the Disco Islands, parts of Ireland and Scotland, and extensive areas of Western America—all were upheaved after the middle of the Tertiary epoch. Large portions of the Mediterranean and the Atlantic Ocean were neither formed till then, and the great changes of land and sea caused by the rivers should also be borne in mind. As we cannot for a moment assume that changes of such enormous magnitude should have neutralised each other, we may safely conclude *that the then Tertiary North Pole had a different situation.* The question then arises: how great is the change which has taken place since the Tertiary period?

Many *savants* have engaged in estimating the extent of the effect of transfer of matter upon the position of the earth's axis, but, as their conclusions disagree, we shall not dwell upon them, but turn to actual experience, such as we possess. For, although we cannot as yet state what terrestrial matter is the most active in causing the change, the fact cannot longer be denied *that a shifting of the Poles still takes place,* and that we cannot consider their position a constant or fixed one. For, when of late, the latest geographical determinations of latitude effected at the observatories of Pulkowa, Königsberg, and many others, were compared with those made in these places centuries and even decades ago, it was found *that every one was situated further south,* the change amounting even to upwards of one second of an arc per century. This change is certainly very small, and it has been suggested that it might be due to defective instruments, an explanation which, however, we can hardly accept when the shifting of the meridian in all places is shown *to take place in the same direction.* Prof. Gyldèn, for instance, accepts the shifting at Pulkowa as a *fact* that cannot be disputed, and considers that a change in the terrestrial body may cause this alteration of latitude.

We now appear to have left the stage of *probability* as to a shifting of the Poles taking place for one of *reality,* and we are even beginning to understand the *rate* at which this change at present takes place; for if we assume that the forces now at work—never mind which—continue to act as heretofore, the latitude should in 6,000 years have shifted one minute of an arc, and after 360,000 years one degree, and in order that the shifting should amount to 10 or 20 degrees, and continues uniformly, a period of 3,600,000 and 7,200,000 years, respectively, would be required.

And where, then, should we arrive in seven million years? Shall we then have reached the middle Tertiary period? Undoubtedly not. We should have *to double the figure.* Students, who in their study calculate the length of geological periods, give, no doubt, lesser estimates, but the geologist, who in nature observes the generally slow influences of the geological forces and the stupendous results still achieved, is not deceived by such calculations.

Having thus found that a shifting of the North Pole of from 10 to 20 degrees between the middle Tertiary and the present period is quite possible, we will return to the testimony of the fossil flora in the matter.

As already stated, it has been insisted that the North Pole is surrounded with such a chain of fossil floral deposits that it is impossible that it could have been differently situated in the Tertiary period. However, *this assertion cannot be maintained now,* as when that theory was advanced no other deposit of fossils in Northern Asia was known than that of Kamschatka, and a shifting in that direction was not excluded.

Already, when the great Professor Heer described the fossil plants from Alaska collected by Herr H. Furuhjelm, the Finnish geologist, and which now forms part of our national museum, he drew attention to the circumstance that this flora indicated a climate less warm than that of the other Tertiary flora in the same latitude. In a still greater degree this became apparent when the said *savant* examined the Tertiary flora from the Island of Sachalin, in Siberia. From this Heer drew the conclusion that also during the Tertiary period the isotherms passed lower down in the regions now corresponding with eastern Asia than in Europe, but he does not from this seem to have concluded that the position of the Pole was then different from what it is at present. When the writer, during the *Vega* expedition, examined the fossil flora discovered by Nordenskiöld, at Mogi, in southern Japan, it became further clear that this flora bespoke a climate which was colder than that now prevailing there, but, this flora being comparatively a young one, the circumstance was naturally connected with the lowering of the temperature during the Ice Age. However, the writer has since had an opportunity of examining and describing the Tertiary plants collected by the Geological Survey of Japan, and in doing so he has made the remarkable discovery *that the middle Tertiary flora of Japan does not bespeak a warmer climate at all.*

This is the more remarkable as the fossil deposits in Japan are found in 35° to 40° lat. N., whereas in Europe, where they are situated far more northerly, they bespeak a much warmer climate than that now prevailing. Indeed, many deposits in Europe, as, for instance, that at Oeningen (in Baden, near the Swiss frontier), boast fossil palms.

Therefore, this great contrast between the Tertiary flora of Europe and Japan cannot any longer be explained by a curve due to accidents of the isotherms in eastern Asia, but must be due to far more weighty causes. The conditions become still more remarkable when we examine the contemporaneous Tertiary flora in Greenland, which, although situated in 35° to 40° latitude further north than that of Japan, bespeaks a climate at least as warm as that of the latter country at the same

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period. But Greenland is situated diametrically opposite to Japan around the Pole. The question, therefore, suggests itself: *Cannot these inexplicable discrepancies have been caused by a movement of the Pole approximately along the Japanese-Greenland meridian?*

This question is conclusively answered if we, by way of experiment, assume a shifting of the North Pole of about 20 degrees; in other words, that the Miocene Pole was situated in about the 70th degree of latitude N. and 120° E. (from Greenwich). The Tertiary flora of Japan would then have been found between latitude 53° and 55° N., and that of Greenland between latitude 51° and 53° N., and, if we test the testimonies of all other known Tertiary flora, they harmonise completely with the assumption of such a position of the Pole. Moreover, the circumstance that the deposit at Oeningen contains so many palms becomes also quite natural, as this place would then have been situated in latitude 36° N., or, in other words, in the same latitude as the present Algeria.

And the assumption of such a position of the North Pole during the Tertiary period *is confirmed in the southern hemisphere*, as we know from Chili, in 35° lat. S., of a fossil mollusc bed from the early and middle Tertiary period, which, like the middle Tertiary flora of Japan, contains no species of a tropical climate. This hitherto inexplicable problem is also easily solved by assuming a shifting of the Poles, as the molluscs in question would then have existed 20° nearer the South Pole than at present.

It would, therefore, seem that, at all events *at present* and with the knowledge at our disposal, the fossil flora of the Polar regions, bearing testimony of a far warmer climate, may easiest be explained by assuming a shifting of the Poles to have taken place; for, although certain difficulties have to be explained which space does not permit me to refer to here, none of them is of such a nature and importance as to refute the theory advanced. It is, however, designedly that I emphasised "at present," as the history of science so often shows that an hypothesis which at one time appears to render everthing explained has in course of time to make room for a better one.

Should this be the fate of the present one, too, it may at all events be hoped that it is a step forward towards the solution of one of the most remarkable and interesting problems of science. In that case wide fields should have been opened to the *savant*, and we may anticipate the solution of many a problem which has hitherto defied it, and of which it may be said, in the words of a famous scientist, "That one feels almost inclined to envy coming generations for the many interesting problems which shall fall to their lot to solve!"

Types of Metamorphosis in the Development of the Crustacea.

By Isaac C. Thompson, F.L.S., F.R.M.S.

Presidential Address, 1890, Liverpool Microscopical Society.

In casting about for a subject upon which to offer some remarks when I occupy for a second term this honourable position in which your kindness has placed me, I decided upon one which, in the course of one line of microscopical investigation continued over some years, has constantly come before me, and often in a most perplexing manner.

Anyone who has spent much time in the examination of the forms of microscopic life existing in myriads throughout our seas, lakes, and oceans, and especially near the surface, must, if continuously done throughout the various seasons of the year, have been struck by the enormous amount of ova frequently found, as well as a still larger amount of immature forms, belonging chiefly to the great divisions of the Invertebrata—the Coelenterata, Echinodermata, Vermes, and Arthropoda, the two latter being represented through their classes, the Annelids and the Crustacea.

It is upon the last of these, the immature or larval forms of the Crustacea, that I wish to speak this evening, and will, therefore, take as a subject *Types of Metamorphosis in the Development of the Crustacea.*

At the outset I must say that the subject is by no means an easy one, and opens a wide field for further investigation by tracing out the development and life history of various marine forms at present but little known. I will endeavour to place before you the leading divisions and orders of the Crustacea, and point out something of the metamorphosis occuring in the various branches of this most interestng division of the animal kingdom, which, though so general in type, probably presents more peculiarities of structure, both in the young and adult stages, than any other branch of Invertebrate zoology; nor is there any group in which the larval forms more clearly indicate its primitive character? Until within the last half-century the well-known fact of the metamorphosis undergone by insects after leaving the egg was considered to be one of the chief distinguishing features separating the Insecta from the Crustacea; Leach and other naturalists laying stress upon this point. The history of the discovery that the common crab undergoes a real metamorphosis (*fig.* 1), now so well known to us, is very interesting, illustrating most graphically how a great truth more than dimly guessed at may be for long obliterated or even crushed out through a groundless confidence in the authority of a votary of science.

The credit of the discovery is generally given to Mr. Vaughan Thompson, who, in the year 1823, thought well to follow up an observation of a Dutch naturalist, Slabber, made in 1768, and published ten years later, that the creatures of the genus Zoœa passed by metamorphosis into a different and a higher form. Vaughan Thompson was thus led to extend his observations, and, in a paper read before the Royal Society in 1835, was able to demonstrate the fact that the common crab in its progress to maturity from the time of hatching goes through two stages, known as Zoœa and Megalopa, these having previously been considered as generic types. It is only fair to the memory of the Dutchman Slabber to qualify the credit ascribed to Thompson, for it was he who many years before had stifled further investigation on the subject by his authoritative published statement "that Slabber lost his Zoœa in changing the sea-water, and that the new form came from the added portion"—a statement made through ignorance and the lack of experimental research. Time will not permit of following up the details of this interesting discovery further than to add that Vaughan Thompson's observations did not go unchallenged, his conclusions being strongly contested by Westwood, who, in a paper read before the Royal Society in June, 1835, and for which he received the honour of its gold medal, says that that gentleman's views are erroneous, and that "*no exception* occurs to the general law of development in the Crustacea, namely, that they undergo no change of form sufficiently marked to warrant the application to them of the term metamorphosis."

Milne Edwards for a time sided with Westwood, but the latter soon withdrew and amply apologised for his too hasty criticism; and, with the aid of other naturalists, the whole question was finally for ever settled in 1843 by Mr. Couch, of Penzance, who established the fact of metamorphosis in no less than ten families of Crustacea.

Those interested in the details of the controversy will find a full statement in the introduction to Bell's *Stalk-eyed Crustacea.*

From the time of Couch to the present very much has been done in determining the many changes undergone by the Crustacea, and, owing to the labours of such men as Agassiz, Spence Bate, Bell, Westwood, Claus, Fritz Müller, Sars, Woodward, and others, it is now a well-ascertained fact that, with a few exceptions, nearly all at anyrate of the marine forms undergo metamorphosis of some form after quitting the egg. Some few of the Podophthalmata, however, including the common cray-fish and one or more species of land crabs as well as the terrestrial Isopoda (which include the common wood-louse) leave the egg with the same number of segments as their parents.

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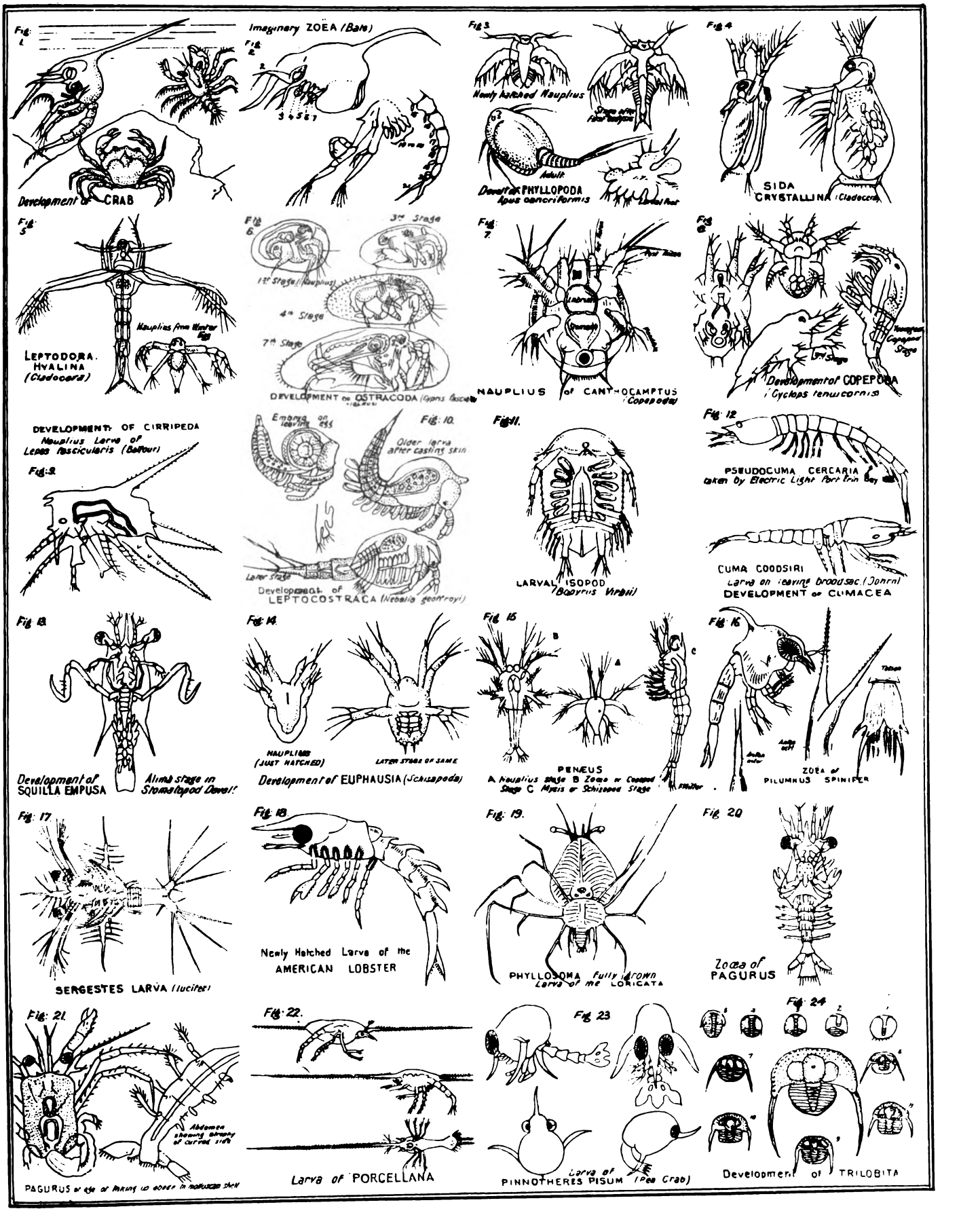
Illustrations of Types of Metamorphosis in the Development of the Crustacea.



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Of the various systems of classification of the Crustacea that of Claus, nearly adopted by Ray Lankester, appears to me the most natural and simple, and in connexion with the subject of development will, perhaps serve better than any other.

ARTHROPODA.

CLASS CRUSTACEA.

I.—ENTOMOSTRACA—

1. Order *Phyllopoda.*
   1. Sub-order *Branchiopoda.*
   2. ,, *Cladocera.*
2. Order *Ostracoda.*
3. ,, *Copepoda.*
4. ,, *Cirrepedia.*

II.—MALACOSTRACA—

1. *Leptostraca*
2. *Arthrostraca* { *Amphipoda.* / *Isopoda.*
   1. Order *Cumacea.*
   2. ,, *Stomatopoda.*
   3. ,, *Podophthalmata.*
      1. Sub-order *Schizopoda.*
      2. ,, *Decapoda.*
         1. *Macrura.*
         2. *Brachyura.*

III.—GIGANTOSTRACA—

1. Order *Merostomata.*
2. ,, *Xiphosura.*
3. ,, *Trilobita.*

Crustaceans in the adult condition have usually a hard chitinous skin, and are made up of 21 somites; occasionally more and often less through coalesence, as in the younger stages and when of sexual advantage. These various somites may be well seen and studied in the anatomy of the lobster or cray-fish. The 21 somites are generally distributed in three equal numbers amongst the three chief divisions of the body, thus—cephalon, 7; thorax, 7; abdomen, 7.

The same general arrangement may be seen in a Zoœa (*fig.* 2), the various appendages being, of course, undeveloped.

In connexion with the various stages of metamorphosis undergone by the immature animal, nearly all Crustaceans undergo a most remarkable moulting or periodical casting of the shell. This is as necessary to the Crustaceans during growth as it would be to our children were it the fashion to dress them, say, in iron armour. The animal retires to a quiet corner, where, by an extraordinary and really wonderful effort, it is able to quickly withdraw all its members leaving the old shell often so perfect that it is difficult to believe it is not another animal. I have often watched the change amongst shrimps and prawns in confinement, and have noticed it occur every two or three weeks, but as the animal advances in age the change is seldom or never required, and from the barnacles and even oysters sometimes found attached to large crabs it is evident the shell could not have been cast for many years.

And now to turn to the true metamorphosis, commencing with the Entomostraca or insect-like Crustacea, of which we have common, familiar examples in every pond, we find four orders—1st, the Phyllopoda or leaf-footed animals, comprising the Branchiopoda and Cladocera; 2nd, the Ostracoda; 3rd, the Copepoda; and 4th, the Cirrepedia.

As typical of the Branchiopoda, the first sub-order of the Phyllopoda, we will take the *Apus cancriformis* or shield shrimp (*fig.* 3), a somewhat rare fresh-water animal about 2½ inches in length, occasionally found in stagnant ponds. It leaves the egg as a nauplius, which form it continues, gradually developing new members throughout a long series of moults until it arrives at the mature form. Unlike the typical nauplius the body is already divided into two parts, the cephalic and the post-cephalic.

In its earliest stage the cephalic region has the three usual pairs of appendages—a rudimentary pair of unjointed anterior antennæ, then a very powerful pair of biramous antennæ as locomotory organs, and lastly, a pair of mandibles, as yet unprovided with cutting blades. A single eye occupies the centre anteriorly, below which is a labrum of remarkable size. In the lower or post-cephalic region are the rudiments of five segments, with their appendages, most uncommon in the nauplius stage.

After the first ecdysis the animal loses its previously oval form through the extension of the posterior portion, which in subsequent stages becomes forked, the maxilla and other organs also appearing. A heart appears with the second ecdysis, and at the third paired eyes arise, one on each side of the previously unpaired eye.

After the fifth ecdysis the nauplius undergoes a rapid atrophy; the second antennæ are greatly reduced in size, and the previous portion of the mandibles disappears, leaving only the cutting portion. Many other ecdyses occur before the animal reaches its maturity.

Were we merely to look at the common adult forms of the Cladocera (*fig.* 4) most known to us, as Daphnia, Sida, Bosmina, &c., we might naturally wonder at their classified position as a branch of the Phyllopoda. But here appears the necessity of studying the larval forms of all genera and species, for by so doing we are often able to discover rudimentary or disused organs, which at once enable us to assign them their true phylogenetic position. The majority of the Cladocera emerge from the egg endowed with all the appendages of the mature adult, as seen in a familiar example, the Sida crystallinus (*fig.* 4); and, as I propose this evening to deal almost exclusively with changes taking place after leaving the egg, the deeply-interesting embryological characters can be hardly touched upon. With regard to the Daphnia, Weissman has observed that the embryo possesses three complete pairs of jaws, two of which entirely disappear and do not develope into jaws in any species. But in that extremely beautiful Cladoceran, the *Leptodora hyalina* (*fig.* 5), until recently thought to be very rare in Briton, but which must be more widespread than supposed, as I have lately taken it at considerable depths in most of our English lakes as well as in tow-nettings from Loch Erne, in Ireland, an extraordinary phenomenon occurs which exhibits its true Phyllopodian ancestry. *Leptodora* is considered by Balfour to belong to one of the most primitive of the Cladoceran families, and it was long known that the summer eggs developed without any metamorphosis. The remarkable discovery was, however, made by G. O. Sars, of Christiania, that in winter the larva leaves the egg in the form of a nauplius (*fig.* 5), closely resembling that of the Phyllopoda. An illustration will at once show its general resemblance to the larva of *Apus*, previously described. In three moults the adult form is attained.

The Ostracoda (*fig.* 6), our next order, is a most ancient one, occurring in nearly all the geological formations, though, unfortunately, their shells only are preserved to us. We all know a very common example in the *Cypris* of our ponds, and the marine forms are extremely numerous and diversified. As their name implies, they are from the embryonic state enveloped in a shell of a bivalve character, the larva having the characters of a true nauplius, with the usual three pairs of members. Claus, who has studied the very complicated development of this group, has observed it to pass through nine evolutionary stages of development before reaching the adult form.

Passing on hastily to the next order, the Copepoda (*figs.* 7 *and* 8), of which the common *cyclops* furnishes a most familiar example, we come upon a very varied state of metamorphosis in the different divisions composing it. Some are very degraded and live only a parasitic existence, the free swimming genera being probably the oldest and most degenerate of this division of the Crustacea, while a few species possess a heart, the eye in the same species somewhat approaching that of the higher pedunculated forms of the Decapoda.

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The larva first emerges as a true nauplius, and it was here that the term nauplius was first used by O. F. Müller upon the supposition that the animal was a mature form.

Although the various genera of the free swimming Copepoda present slightly varied forms of nauplii the general character is the same, as exhibited in the oval form and the usual three pairs of appendages. After several ecdyses the posterior portion is lengthened, and in time developes into a caudal fork, when the animal assumes the Copepod form, or the early cyclops stage *(fig. 8.)* In time the swimming feet (usually five pairs) are developed, and the powerful posterior antennæ are greatly reduced in size, the anterior antennæ being correspondingly developed and further joints added thereto as it approaches the adult form. And here it is well to say that the number of stages passed through in this and other orders of the Crustacea renders it extremely necessary to be very careful before pronouncing decisively upon a species supposed to be new, the advanced larval forms being very misleading, especially to a novice.

The parasitic and semi-parasitic species of Copepoda undergo a different metamorphosis from the free swimming species. The Lernæa, an uncommon genus of which I have found some examples in our district, leave the egg as a very modified nauplius, and, after reaching the adult form, undergo a remarkable retrogressive development.

The parasite Argulus, common upon our fresh-water fishes, has no nanplius stage, but is hatched in the cyclops stage, closely resembling the adult in general form. It has, however, then the appendages of a true larval Copepod, and reaches the adult condition through a number of varying ecdyses.

The true position of the Cirrepedia as degraded Crustacea was first made known through the elaborate researches of Darwin on this order while studying their stages of development and life history. Here, again, we see a considerable diversity of form in the different divisions of the order. Nearly all the species, however, leave the egg in the nauplius form, and in various ways, closely resembling both the Phyllopod and Copepod larvæ. Passing from this stage through numerous moults, long serrated spines appear, one forming the tail as in Lepas *(fig. 9)*, and this animal has a strong dorsal shield. Hence it passes into the cypris stage, new appendages being added, including the rudiments of six pairs of feet and the rudiments of a disc on the antennæ, by which in a later stage the animal attaches itself.

Passing through the short, free cypris stage the pupa condition is reached, during which the animal attaches itself by the antennal disc, a cement-gland supplying the necessary mucilage. All the nauplian spines are lost as development advances, and while several new structures are being formed a retrogressive metamorphosis of previously formed structures commences, both externally and internally. The eyes disappear, as also the bivalve shell acquired during the cypris stage, and the caudal appendage becomes aborted as the animal passes into the adult form.

Can we be surprised that the appearance of the mature Cirrepedes, as represented by the Balanus or Lepas, should have led pre-Darwinian naturalists to place them amongst the Mollusca rather than the Crustacea; but with their life-history and remarkable metamorphosis before us it becomes perfectly evident that they are real, though very degenerate members of the Crustacean family.

And now we pass from the Entomostraca to the second and chief division of the Crustacea, the Malacostraca. A knowledge of the derivation of words is of the greatest possible service in studying and remembering zoological terms and names; and bearing this in mind it seems anomalous that the name Malacostraca (from *malakos*, soft, and *ostrakon*, a shell) should be applied to the division which includes the lobsters, crabs, and other hard-shelled animals. When, however, we know that the name was originally applied by Aristotle to the entire class Crustacea, because their shells were softer than those of the Mollusca, the seeming anomaly is at once explained.

Most systems of classification have divided the various groups of Crustacea into two divisions, the Podophthalmata, or stalk-eyed, and the Edriophthalmata, a sessile-eyed species, but in the more recent classification of Claus, which we are using this evening, the Malacostraca are divided into three groups :—1st, the Leptostraca, or slender-shelled; 2nd, the Arthrostraca, or jointed-shelled; 3rd, the Thoracostraca, or breastplate-shelled.

A very varied and complicated metamorphosis is general throughout the Malacostraca; some few of its members, however, leave the egg in nearly the adult form. There is seldom a nauplius stage so general amongst the lower division we have just considered, the Entomostraca, the Zoœa being usually the first free larval stage.

The first group, the Leptostraca, contains only one living genus, the Nebalia *(fig. 10)* a most interesting animal, forming a striking connecting-link between the Entomostraca and the Malacostraca. In general appearance *Nebalia* most nearly resembles the stomatopod shrimps, possessing, as it does, pedunculated eyes and a long abdomen with appendages. But, attached to the thoracic segments are eight pairs of feet, with leafy terminations so similar to those of the Phyllopoda that Milne Edwards, Leach, and most naturalists to the present time have classified it under that order. From the distinct articulations of the thorax and abdomen it must, however, continue to hold the higher position to which Claus and others have assigned it amongst the Malacostraca.

The various species comprising the genus Nebalia are all marine. While still in the egg they go through the nauplius and Zoœa stages, and thus to a large extent lessen the chance of their destruction at the moment of birth. The animal is enveloped in a larval skin on leaving the egg, the subsequent metamorphoses being slight. Most of the appendages are already present, and, like the Mysis, which it also resembles in many respects, has its abdomen bent upwards dorsally while still a larva.

In the second group, the Arthrostraca, we have two large and important orders both well represented in our district, the Amphipoda and Isopoda.

The former, although so varied in structure, need not here occupy our attention, inasmuch as there is no marked general metamorphosis, all the segments and limbs being formed before the animal leaves the egg. In the Isopoda, the second of these two orders, which under the classification of Dana and Spence Bate comprise the Edriophthalmata, or sessile-eyed Crustacea, we have a decided metamorphosis, varied in the different families, but in none very elaborate. In the Bopyridæ, a family of parasitic Isopoda *(fig. 11)*, the youngest larvæ assume an ovate form much resembling the common woodlouse (itself an Isopod), with much enlarged posterior antennæ, probably of great use as locomotary organs, but possessing no trace of the last (the seventh) pair of thoracic feet, while in another family, the Tanaidæ, the abdominal feet are entirely wanting in the earliest free larval stage. Other important modifications of various members take take place as the Isopoda assume the mature form.

The third group of the Malacostraca, the Thoracostraca, is the most important, containing the orders the Cumacea, Stomatopoda, and Podophthalmata, embracing all the crabs, lobsters, shrimps, prawns, &c., the greater number of their genera possessing more or less elaborate metamorphoses. But to this rule we come across most important exceptions, the first being the case of the Cumacea *(fig. 12)*, in which the larvæ have all the segments of the adult form, but are hatched without the last pair of thoracic feet, or any of the abdominal feet, the latter being never developed in the female. In other respects the larva strongly resembles the adult form *(fig. 12)*.

The Stomatopoda *(fig. 13)* present a complicated metamorphosis which, though still but imperfectly worked out, has been much elucidated by Claus. He found that glassy shrimp-like animals, long

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known as Alima and Erichthys (*fig.* 13), and supposed to be adult forms, were but larval stages in the life-history of the *Squillæ*, marine crustaceans, chiefly found in the warm southern seas. In its earliest post-embryonic condition the Ericthus larva is a very striking object, conspicuous by its formidable spinous carapace, which surrounds the body like a mantle; it has already complete body segments, but no abdomen except a caudal plate.

It thus differs very conspicuously from the Zoœa of the Decapoda, with which we shall have to do presently. Near to the short, simple antennæ and the mouth organs are five pairs of swimming feet. The three last thoracic segments possess no appendages, being terminated by the caudal plate, sometimes mistaken for an abdominal somite. In a more advanced state of development five thoracic rings with appendages make their appearance, and the tail acquires two side paddle-like plates. Large pedunculated eyes are in front, immediately behind which the dorsal shield is attached, and is anteriorly prolonged into a formidable spine. Two posterior lateral spines are developed, and one median spine. As development proceeds the first pair of antennæ becomes two-branched. The inner branch of the second pair of maxillipeds increases in size and acquires a large terminal claw, the outer branch becoming aborted. The abdominal segments and appendages gradually develop in succession from before backwards, until the full number is reached. Other changes occur as maturity is reached, the process of metamorphosis varying in different genera.

I have recently found a considerable number of these squilla larvæ (*fig.* 13) in some very rich-surface tow-nettings taken in the Indian Ocean, and kindly placed in my hands for examination by our colleague, Mr. T. W. Bruce, and upon which I hope to report more fully at some future time.

With the sub-order Schizopoda we enter upon the Podophthalmia proper, this large and important group being probably the most primitive form of the order. In it the original characters of the group appear to have undergone least modification, this view receiving strong confirmation from the fact, as pointed out by G. O. Sars,* that "a vast number of the higher Podophthalmia pass during development through a larval stage—the so-called Mysis stage—calling to mind in a most striking manner the Schizopod type."

As its name implies (from *schisis*, a splitting, and *pous*, a foot), the most marked feature of Schizopoda is the possession of natatory branches on all the limbs of the trunk.

It is naturally divided into four divisions :—1, Lophogastrida; 2, Eucopiida; 3, Euphausiida; 4, Mysida, and is well represented in our own seas, being very widely distributed.

The development of the Schizopoda is in general very similar to that of the Isopoda in passing through the pupa stages before being hatched. The Mysis embyo leaves the egg with three pairs of appendages like a nauplius, the larva undergoing its further development within the incubatory pouch of the parent, this pouch being situated beneath the cephalotharax.

The Euphausiidæ, however (*fig.* 14), go through a very complicated free metamorphosis, leaving the eggs in a very immature condition as true nauplii, and in this respect resemble the lower forms of Entomostraca. The same low mode of development is again seen in some Decapoda.

Much light has been thrown upon the metamorphosis of this interesting family the Euphausiida, of late years by various naturalists, particularly by Professors Claus, of Vienna, and G. O. Sars, of Christiania, and later by Messrs. Brook and Hoyle, in our own country. And here again we see the very careful study of life-history so necessary before deciding upon an apparently new species as a true one. Dana, in his great work on the *Crustacea of the United States Exploring Expedition*, established three new genera of Schizopoda :—1, Calyptopis; 2, Furcilia; 3, Cryptopia. They have been subsequently shown by Claus to be but different stages in the development of Euphausiida, and, as in the case of Zoœa and Megalopa, the original names are retained to represent the stages of their life-history, as they do not correspond with the Zoœa and Mysis stages of other Podopthalmia. In order they come after the nauplius and metanauplius stages, showing five clear metamorphoses.

In entering upon a consideration of the metamorphosis occurring in the second sub-order of the Thoracostraca, the Decapoda, or ten-footed Crustacea, we are dealing with the very well-known classes of animals—the lobsters, crabs, and crayfish, as well as the prawns and shrimps, and here I am painfully cognizant of the probable fact that most of my audience, if separately polled, would be found to agree that any discussion of the higher Crustacea is much more interesting when conducted at the supper table than in a presidential address. Being, therefore, in an overwhelming minority, I must crave the indulgence of those present if I urge the antigastronomic claims of the Decapoda as most deeply interesting and worthy of careful study.

All the marine known genera and species undergo metamorphosis. There are, however, two animals—one a land species and the other inhabiting fresh water—a West Indies land crab and the European crayfish, which quit the egg in the form of their parents and possessing the full number of jointed appendages.

The Decapoda has usually been divided into three families :—

1. Macroura, or long tailed (lobster, &c.)
2. Anomura, or irregular tailed (hermit crab, &c.)
3. Brachyura, or short tailed (shore crab, &c.)

Recent carcinologists have, however, considered the Anomura as probably but irregular forms of Macroura and Brachyura, and are most likely the descendants of Crustacea in which some retrogressive variation has become persistent.

The vast majority of the Decapoda quit the egg as Zoœa without going through any nauplius stage; but, as an example of the well-known biological truth that the development of the individual is an epitome of the development of the whole race, or, to put it more concisely, that ontogeny recapitulates phylogeny, we find that one or more species of prawns, of the genus Penæus (*fig.* 15) leave the egg as typical nauplii, and we may, therefore, look upon them as probably representing the ancestral history of the Decapoda.

Frank Buckland has aptly described the Zoœa as a larva with "goggle eyes, a hawk's beak, a scorpion's tail, and a rhinoceros' horn, which adorn a body fringed with legs, yet scarcely bigger than a grain of sand."

In this very early stage of its existence the spines are probably of great service to the Zoœa as a protection against attack from large free swimmers, but in a short article in the *Journal of the Marine Biological Association of the United Kingdom* for October, 1889, by Mr. W. F. R. Wedon, M.A., entitled "Note on the Function of the Spines of the Crustacean Zoœa," another theory is given. Remarking upon the tendency of the Zoœa larvæ spines to develope in one straight line parallel to the long axis of the body, the author notes that the portunid larva was seen to swim lying on its back, and to row itself with its maxillipeds "exactly in the manner of two men sculling a narrow boat, the steering being effected by means of the tail." His theory is that those larvæ possessing spines swim in an absolutely straight line towards the light, while those without spines, as the shrimp and prawn, go in a succession of ill-directed spirals.

Apropos of the liability of newly-hatched Crustacea to be attacked by stronger foes, I came across a remarkable statement the other day by Mons. Paul Gourrat in *Annales du Musee d'Historie Naturelle de Marseille.* The paper is entitled "Considerations sur la fauna Pelagiques du golfe de Marseille." The writer remarks that he and

Challenger Report on the Schizopoda. G. O. Sars, p. 8.

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Professor Marion have observed the hatching of more than fifty species of Decapoda, and they find that, with one single exception, the hatching takes place during the night, and, if not terminated by daybreak, it is stopped, to be continued on the following night. The one exception is that of *Pilumnus spinifer* (*fig.* 16), a species of crab found among the heavy corals at a depth of 50 metres, and which, when placed in a globe of water, hatched its ova between noon and three p.m. The observers remark that this phenomena may doubtless be accounted for by the fact of the extreme weakness of the larva during the earlier moments after their birth, and they would doubtless be exposed to many dangers during the daytime which would be escaped during the night. These observations are extremely valuable, and the facts they record appear to be hitherto unrecorded in this country.

The Macroura, or long-tailed Decapods, are comprised in about twenty families and snb-families, and the Brachyura, or short-tailed, in about twenty-six families. I propose to touch upon only a few typical examples of each to illustrate the mode of metamorphosis of the whole.

Commencing the Macroura with *Penæus* (*fig.* 15), as probably representing the most ancestral form, we find a return to the true nauplius furnished with the three typical pairs of appendages—the first uniramous, the others biramous; body without any carapace, and terminated by two strong setæ. After one or two moults the Zoœa stage is reached, when a cephalic shield has appeared with two pairs of antennæ and the maxillipeds. The tail has developed to quite the length of the body, and the segments of the thorax and abdomen are indicated though their appendages are not present. From the Zoœa the larva passes into a much higher state of development, variously known as the Schizopod, Mysis, or Copepod stage. Here the antennæ are considerably modified, and the thoracic and abdominal feet appear, and in another moult the complete adult form is reached.

No other example of a free larva in the nauplius stage is known among the Decapoda. In the Sergestes, the larva of the Lucifer (*fig.* 17), we have a most remarkable larva, examples of which have been recently found by Miss Thornely, amongst tow-nettings taken by Dr. Bruce in the Mediterranean around Malta. It is extremely spinous anteriorly, laterally, and posteriorly. The larva in this stage was first described by Dohrn, and known as *Elaphocaris*. It next assumes another animal, formerly known as *Acanthosoma*, resembling here the Schizopod form of *Penæus*, and, before attaining the adult condition, it passes through yet another stage, the *Mastigopus*, in which most of the spines are lost, the abdomen is considerably elongated, and the conspicuous eyes have long stalks, other changes taking place in the maxillipeds and thoracic limbs before the final moult.

Passing over the Palæmonina and Crangoninæ, the prawns and shrimps, which are hatched as Zoœa, and go through a Mysis stage, we come to the Astacidæ, which includes the crayfish and lobsters.

As before stated, the crayfish, like the Cladocera, forms one of the remarkable exceptions to the rule that Crustacea undergo metamorphosis, for, except in unimportant details, it leaves the egg in a form nearly resembling that of the adult.

The lobster (*fig.* 18), although so very similar in structure to the crayfish, undergoes a slight metamorphosis as it leaves the egg in the Mysis form, going through two or three ecdyses before reaching maturity.

Most of the Zoœa whose development has been observed posses. sufficiently clear distinguishing features to be easily recognised. Amongs these is the Zoœa of Galathea which, according to Bate,* "may be distinguished by the posterior margin of the carapace being definitely serrated by two dorsal teeth in the posterior margin of the somites of the pleon; by the extremely long ovate eye occupying about one-half the length of the carapace; by the presence of a sharp serrated tooth at the distal extremity of the basal joint of the second antennæ; by the shortness of the cylindrical branch that terminates in a small tooth and one ciliated hair; and the sharply pointed distal angle of the squamose branch of the same antennæ."

A very curious and interesting metamorphosis occurs in the Palinuridæ (Loricata). The glass crabs, long known as Phyllosoma (*fig.* 19), remarkable transparent creatures found as free swimmers in Southern Oceans, easily recognised by their long, narrow eye stalks and absence of body segmentations, were doubtfully considered by one or two naturalists to be but larval forms of some Crustacea. This hypothesis was proved to be true by Dohrn, who actually succeeded in raising them from the eggs of Scyllarus and Palinurus, the two forms having slight structural differences in the larval states. Dohrn noticed that some of their most remarkable features of metamorphosis occured before hatching.

The stages from the Phyllosoma to the adult forms have not yet been made out. I have found several specimens of Phyllosoma (*fig.* 19), in the surface tow-nettings before alluded to, taken in the Indian Ocean.

Surely, nothing in the whole range of zoology can be more remarkable than the case before us. We have seen how slight a metamorphosis is undergone by the common lobster, and none by the crayfish, and yet, here in a closely-allied family, the Loricata, we find the most extraordinary transformation taking place between the hatching of the egg and the attainment of the adult form; a metamorphosis so unique and inexplicable as to fill the mind with wonder at the causes which could lead to such a digression from the ordinary course.

Foremost among the Anomura or irregular-tailed, were such a division still retained, would come the Paguridæ, or hermit crabs, which though eminently Macrurian and distinguished from the rest of their class by possessing a soft uncalcified abdomen of unsymetric form, and in which most of the appendages have become atrophied or abortive through the animal having long ago changed its mode of life. Leaving the egg as a Zoœa (*fig.* 20), the same form continues in a more developed condition through two or three stages, during which the appendages of the sixth abdommal somite are modified into clasping organs, their function being to obtain a firm hold of the columella of the empty shell in which the animal resides. At the same time one of the chelæ is abnormally enlarged in order to act as watch-dog at the door.

No Mysis stage is passed through between the Zoœa and the adult form, one of the intermediate stages showing a bending of the abdomen to one side (*fig.* 21) so characteristic of the adult animal.

Passing on to the Brachyura, or short-tailed Decapoda, we are amongst the many varieties of the crab family. Almost all leave the egg in the Zoœa form, the spines being usually frontal and dorsal, and sometimes also lateral or posterior. Next comes the Megalopa stage, no intermediate Schizopod stage intervening, thus considerably abreviating the metamorphosis. The Megalopa form varies in different genera. In most the anterior portion of the animal is nearly fully developed, the Maxillipeds being much reduced in size since their former function as swimming feet has ceased. The other appendages and swimming feet are developed, and the forked telson usually so conspicuous in the Zoœa, is transformed into an oval swimming plate. Sometimes, as in the younger Megalopa of the *Carcinus mœnas*, the common shore crab, the Zoœa spines are but little modified; in others they are greatly reduced, while in the Megalopa of Portunus they are entirely absent. In a few moults the Megalopa attains the adult stag by a gradual development.

The Zoœa of the Porcellana (*fig.* 22) is most remarkable in appearance, easily distinguished from all others, and is frequently taken in marine surface tow-nets. The body is oval, and is characterised by the presence of one uncommonly long anterior dorsal spine and two

* "On the Present State of Our Knowledge of the Crustacea," by C. Spence Bate, F.R.S., *Report of the British Association*, 1878, p 193.

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shorter parallel posterior spines *(fig. 22)*. The mature Porcellana is almost a permanent Megalopa.

One more example, *Pinnotheres pisum*, the little sea crab *(fig. 23)*. The Zoœa, like the last, I often find free swimming near the surface in the Mersey estuary, and, though strikingly different from that of Porcellana, is of so comical appearance as to be easily recognised. I have taken the sketch from random specimens differently placed, by which it assumes different phases. The abdomen, being usually bent under the body, if looked at dorsally it looks like an oval tripod with goggle eyes. I am not aware that its further development has been traced.

Other examples of Brachyuran metamorphoses might be given did time permit, but the foregoing probably represents the most imporatant.

A few words only must suffice for the third Crustacean order, the Gigantostraca (*fig.* 24), which comprises three orders—1, Merostomata; 2, Xiphosura; 3, Trilobita; and the representatives of which are all fossil with the exception of the Limulus, the king crab.

I have included them amongst the Crustacea, as following the classification of Claus; but other authorities, as Ray Lankester, Herdman, and Balfour do not consider them to be true Crustaceans. Prof. Herdman, in his *Phylogenetic Classification of Animals*, places them amongst the Arachnoidea, under the Tracheata, as more near resembling the Scorpion tribe than the Crustacean, and this view is probably the correct one.

It now but remains for me to pronounce a benediction upon this the twenty-first birthday of the Society, which anniversary we are met to celebrate this evening. And, as one who has by your kindness been permitted to take a considerable share in the conduct of the Society in the past, I may be allowed heartily to wish it ever-increased prosperity in the future. Without wishing to appear optimistic, I thlnk I can congratulate the members upon a healthy appearance of work amongst us that augurs well for the future. It is sometimes said that the real work of a Society can be best estimated by the quality and merit of its published transactions. We have made a distinct move in this direction during the past year by publishing the journal, which, though still young, bears evidence of some good original work being carried on. All original investigation should be widely known and disseminated, as can only be done through published transactions, and there can be little doubt that our Journal will prove to be the means of eliciting the record of dilligent study bearing fruit amongst our members, as the character of some of our late papers has already shown. If our excellent Treasurer cannot show us his usual good yearly balance it is because he has well expended our funds; for, as the Report shows, we have made large and most valuable additions to the library during the past year, and to which the Council is most glad from time to time to add standard works, as far as practicable, for the benefit of members working in any special lines not adequately represented.

The cabinet of slides continues to augment under the kind charge of our zealous Curator, who devotes much time and care to its interests. The greater the accession of new members the more can these advantages be increased and extended, for union is strength. We desire to have the co-operation of all microscopists of our city, and should like to enrol them all, if not already members.

In conclusion, let me urge upon our younger members, who may be working in any definite direction, as I know several who are, to give us the value of their work either through communications or papers. Every new fact is worthy of record, and even theories are most valuable as aids towards the elucidation of truth. And in working out the secrets of nature, a sure guide to happiness in life, let no kind, mistaken friend damp your ardour with the too oft-repeated question, "What use is this?" or "What good does it do?" always remembering in the pursuit of knowledge that "nothing can be unworthy of being investigated by man which was thought worthy of being created by God."

Our Portrait Gallery.

XVIII.—PROF. GEORGE J. ROMANES, M.A., LL.D., F.R.S.

WHEN the history of the Victorian Age comes to be written, it will probably be found that its leading feature, so far as relates to scientific progress, will be the remarkable influence which the theory of evolution has obtained, whether applied to the physical or the mental faculties of living beings. In one form or another the effects of the doctrine expounded by the master mind of Darwin have overspread and materially affected the entire domain of modern thought. Even if nothing further had been gained, the discussions engendered by the publication of *The Origin of Species*, and the host of works by which this was followed, have stimulated enquiry, and resulted in a permanent increase of our knowledge.

Following upon the labours of the evolutionist, a new school of naturalists has arisen, who, not content with the simple observation of nature as it appears around them, are occupied in tracing out the different stages of development and successive operations which have produced the existing habits of the animal or functions of the plant.

As a disciple of the Darwinian school Mr. ROMANES is entitled to a prominent and honourable place. Whilst his writings have done much to perpetuate the work of the great master, he has also inaugurated an important advance by applying the Darwinian methods of evolution to the study of Comparative Psychology—so much so, indeed, that he may be said to have created a new science.

The subject of Comparative Psychology had formerly been virtually excluded from the hierarchy of sciences. "If we except the methodical researches of a few distinguished naturalists," writes Mr. ROMANES in the preface to one of his most popular works, "it would appear that the phenomena of mind in animals, having constituted so much and so long the theme of unscientific authors, are now considered well nigh unworthy of serious treatment by scientific methods. But it is surely needless to point out that the phenomena which constitute the subject-matter of Comparative Psychology, even if we regard them merely as facts in nature, have at least as great a claim to accurate classification as those phenomena of structure which constitute the subject-matter of Comparative Anatomy." Acting on this conviction, and aided by an intimate personal intercourse with Darwin himself (by whom he was presented with some original MSS. and clippings collected during forty years of his life), Mr. ROMANES has been enabled to prosecute with vigour many valuable researches on mental evolution in different animals, including man. The works entitled *Animal Intelligence*, *Mental Evolution in Animals*, and *Mental Evolution in Man*, constitute the

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PROFESSOR G. J. ROMANES, M.A., LL.D., &c.

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instalments in which his researches in this direction are being published.

That even this sphere of work does not exhaust the field of his labours will be apparent from the following brief details of Mr. ROMANES' career.

GEORGE JOHN ROMANES was the son of the late Rev. Professor Romanes, M.A., and was born in Kingston, Canada, on May 20th, 1848. He received his early education by private tuition, and spent much of his boyhood in England, France, Germany, and Italy. Entering Gonvilles and Caius College, Cambridge, in 1867, he graduated in Natural Science Honours in 1870, becoming Burney Prize Essayist in 1873, and Croomian Lecturer to the Royal Society in 1875, of which learned body he was elected Fellow in 1879. In this year he married Ethel, daughter and heiress of the late Andrew Duncan, Esq., of Liverpool, by whom he has had one daughter and three sons. In 1881, Mr. ROMANES again delivered the Croomian Lectures on the Locomotor System of Echinodermata, for the Royal Society, shortly afterwards being appointed Zoological Secretary to the Linnæan Society, and receiving the honorary degree of LL.D. from the University of Aberdeen. His work in the *International Scientific Series*, on "Animal Intelligence," has been already alluded to; it consists of a wonderful storehouse of anecdotal facts, relating to nearly all classes of animals, illustrating the principles of Comparative Psychology. Another and more recently published work in the same series, "Jelly-fish, Star-fish, and Sea-urchins," is a popular exposition of his papers on the nervous system of medusæ, contributed some years previously to the Royal Society.

Mr. ROMANES is an active contributor to the periodical literature of the day, besides to scientific memoirs of the learned societies. A paper, read by him several years ago before the Linnæan Society, entitled "Physiological Selection: an Additional Suggestion on the Origin of Species," gave rise to much controversy, as the "additional suggestion" is generally understood to amount to an attempt at supplanting Mr. Darwin's theory of natural selection, but this interpretation Mr. ROMANES himself repudiates. As a lecturer he is equally well known. At the Dublin meeting of the British Association he gave the evening discourse on Biology, and, in 1885, the Rede Lecture at Cambridge. For the past five years he has held the office of Rosebery Lecturer on the Philosophy of Natural History to the University of Edinburgh, and is at present holding the appointment of Fullerian Professor of Physiology in the Royal Institution of London.

Throughout his career, the most careful examination of nature has been a strong point of Mr. ROMANES' work, and upon this he has been enabled to base conclusions and to lay down principles which have been of the highest service to students of the all absorbing science of Biology.

O. W. J.

Notes in Brief.

A NEW society has been formed in Edinburgh, under the title of the Scottish Microscopical Society. We wish the members every success in their undertaking.

ASTRONOMERS throughout the country will regret the loss of so capable and keen an observer as the late Father Perry, F.R.S., who died from dysentery during his eclipse expedition to the Salut Islands. So far as has been learnt, the results of the several expeditions are not so good as had been expected. Observations of the African parties were frustrated by clouds, and no photographs were taken of the total phase of the solar eclipse.

THE author of a delightful little octavo volume of essays, entitled "By Leafy Ways," announces as ready for publication a companion series under the title of "Idylls of the Field." It will consist of sketches of country life and scenes in the well-known style which Mr. F. A. Knight made so popular when his sketches first appeared in the *Daily News*.

THE new editorial sub-committee of the Selborne Society's magazine, *Nature Notes*, have issued an elaborate programme of their monthly venture, which is announced to appear on the 15th of each month. One main object of the journal is stated to be the establishment of "a connecting link between uninstructed love of nature and accurate scientific knowledge."

MESSRS. MACMILLAN & Co., Bedford Street, Strand, London, have issued a new catalogue of educational works which includes many useful volumes in Natural Philosophy, Chemistry, Biology, Anthropology, Geology, and Agriculture. Amongst these is a new Elementary Class-book of General Geography, by Dr. H. R. Mill, F.R.S.E., who is well known as one of the prominent leaders of the modern school of geographers.

MORE subsidences are reported at Northwich. The area affected seems to increase, and in one of the recent cases a chasm seventy feet in diameter extended across the main road between Hartford and Northwich. The gas and water mains are snapped, and shops and houses are endangered. The whole town is, in fact, being undermined, and, so long as pumping for brine and the mining of rock salt are carried on, these occurrences will probably continue to happen.

AT one of the recent meetings of the Clydesdale Naturalists' Society Mr. George W. Ord referred to the spread of alien plants in the Clydesdale district. Two of the principal plants dealt with were the Leopard's bane (*Doronicum pardalianches*), a European continental plant, which has managed to establish itself in many places throughout the kingdom; and *Mimulus luteus*, which is supposed to be of South American origin. The first has been known to grow in one or two localities in the district for many years, and, although regularly visited by successive generations of botanical collectors, has not appreciatively decreased, and it has managed to spread itself to two or three other places, as Mr. Ord found out during his rambles last summer. It would appear that *Mimulus luteus*, too, is destined to become one of our commonest bog and riverside plants, as it already exists in great profusion in many widely severed localities. The colour of the corollas of both these plants is yellow, and the same is the case with *Senecio saracenicus*, another plant which has diffused itself to a considerable extent throughout the country, and Mr. Ord maintains that plants with corollas of that colour are more likely to succeed than any other, yellow being the prevailing colour of the West of Scotland, if not of the whole of Britain.

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THE proposed company for the erection of a Crematorium at Manchester seems to be making progress. One of the members of the Cremation Society has offered to visit, at his own expense, the chief crematoria on the continent, and report to the council as to the best forms of furnaces now in use.

HIS GRACE the Duke of Argyll is announced to deliver, in March, an address to the London Society for the Extension of University Teaching on the subject of "The Application of the Historical Method to Economic Science." An address, equally instructive and even necessary in these days, could well be delivered on "The Value of the Scientific Method as Applied to the Teaching of History."

AFTER March next all lifeboats will be required to carry a gallon of vegetable or animal oil in a distributor of approved pattern, for shedding the oil on the sea in rough weather. Each week proofs are received of the value of oil in stilling the surface waves. The Dunkirk Chamber of Commerce have lately awarded their first prize for successful oiling to a schooner which encountered heavy weather off Portland. Two bags steeped in oil hung out one on each side of the stern sufficed to moderate the breakers.

AN epoch of journal-making seems to have been inaugurated with the new year. Our latest contemporary, the *Field Club* (London: Elliot Stock), edited by the Rev. Theodore Wood, gives promise of usefulness to lovers of natural history. The scope of the venture in its existing form, however, appears to be somewhat too limited for the tastes and aspirations of present-day students of science. The new Saturday review, entitled the *Speaker*, is so framed as to include the progress of science within its ken. The *Daily Graphic* has, as yet, given little sign of attention to scientific lore, whilst science seems to be equally ignored by the editor of the *Review of Reviews*, no names of scientific journals being included in his first record of periodicals of the month.

THE second annual dinner of the Association of Public Sanitary Inspectors (north-western district) was held at Liverpool, on December 14th. Dr. J. Stopford Taylor, who occupied the chair, gave an address, in the course of which he drew a retrospective picture of the insanitary conditions existing in one of our large cities in 1846 (less than fifty years ago), when he commenced practice in Liverpool, and briefly referred to the successive means which had reduced the mortality rate to nearly one-half what it then reached. He urged the necessity of constant and vigilant action on the part of the sanitary staff, whose inspectors have more advantages at the present day, so that the public expect more results from their experience.

IN a valuable paper on the possible future extension of the duties of public analysts, Mr. Alfred H. Allen, F.C.S., urges the amendment of the existing Acts relating to sanitary chemistry and the sale of poisons. It seems a grave public evil that the provisions of the Sale of Food and Drugs' Act does not include other articles besides those coming under the express denominations of food or drugs. Mr. Allen instances several articles, such as olive oil, yeast, petroleum, mixed fabrics, and those containing arsenic over which public analysts should have some definite legal control, and showed how, in a host of ways, in addition to being a scientific body, the Society of Public Analysts might perform very useful functions in the State. During the next session of Parliament it is expected that new legislation will be initiated dealing with the sale of poisons. The opportunity ought not to be lost to urge the importance of modifying the existing laws relating to the sale of foods, &c., and the society should at once draft a Bill embodying their views and forming a foundation on the lines of which the new legislation could proceed.

THE winter course of Free Lectures given under the auspices of the Liverpool Corporation was commenced on 7th January, when Professor R. Caton, of University College, gave an address on "Scandinavia and the Vikings." Subsequent lectures were delivered on various subjects of scientific and general interest. An innovation this year is a short course of two lectures on Saturday afternoons by Mr. Peter Cowell, F.R.H.S., chief librarian, who dealt in the first lecture with "The Printed Book and the Printer," illustrating his remarks by many specimens of rare works and ancient MSS. from the City Library. These lectures are specially designed to interest pupil teachers and others in the rich bibliographical stores available in the Free Library.

PROFESSOR JEFFERSON, in an address to the Leeds Geological Association, on "Minerals as Gems and Precious Stones," referring to the matrix of the diamond, considered that the porphyritic peridotite containing calcite (named *Kimberlite* by the late Dr. Carvill Lewis), to be an undoubted basic eruptive, post-carboniferous rock. It enclosed, however, "a large amount of the adjoining bituminous shale, which has been more or less baked and altered. It is a volcanic breccia, but not an ash or tuff, the peculiar structure being apparently due to successive paroxysmal eruptions." This vegetable matter that formed the probable source of the crystallised carbon may have been derived, the Professor suggests, from this shale.

AN interesting account of the Marine Biological Station at Plymouth recently appeared in the *Field*. The operations of the newly-erected laboratory are proceeding with vigour. Among the naturalists who have made good use of the facilities allowed (a table in the laboratory can be secured at a rent of £5 a month or £40 a year) are Dr. C. A. Macmuna, Professor Burdon Sanderson, Mr. Gotch, Mr. J. F. Harmer, and the Rev. Dr. Norman. The British Association have also obtained a table for the current year, and this table will, under the usual conditions, be open to any properly-qualified naturalist who may apply for it.

FROM the Report of the Entomological Society of London, we learn that the new volume of *Transactions* has extended to nearly 600 pages, comprising 23 memoirs. The president for the year, Lord Walsingham, F.R.S., gave an address, in which he referred to the attractive beauty of some of the larger diurnal *Lepidoptera*, and the brilliant metallic colouring of certain species of *Coleoptera*, the influence that such magnificent examples of the wealth of design in Nature might have on artistic tastes, and the consequent refinement and increased enjoyment of life.

THE University College of North Wales, Bangor, is prepared during the present session to offer short courses of lectures in the principal agricultural centres of North Wales, on the following subjects:—Draining and improvement of land, laying down and management of permanent pasture, farm live stock and the laws of breeding, and dairying and its successful conditions, by Douglas A. Gilchrist, B.Sc., lecturer in agriculture; insects injurious to crops and domestic animal pests, by Philip J. White, M.B., lecturer in zoology; the chemistry of soils and manures and of foods and feeding stuffs, by J. J. Dobbie, M.A., D.Sc., professor of chemistry, and Mr. Gilchrist; diseases of field crops and the plants of the farm, by Reginald W. Phillips, M.A., B.Sc., professor of biology. The department is also prepared to undertake the management of experiments on the different systems of manuring, and on the improvement of permanent pasture. Arrangements for a college course of instruction in agricultural science and for schoolmasters' classes are also being made. The lectures will be given wherever the working expenses (travelling expenses of lecturer, hire of hall, &c.) are guaranteed, and where there is evidence of a *bona fide* interest in the subject among the farmers. Such work by this college cannot fail to greatly benefit agricultural operations in the Principality.

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SCIENTIFIC subjects appear to occupy a fair share of attention at the hands of the various Sunday Societies now established in this country. During January, at the Bristol Sunday Society, Mr. R. McMillan gave an address on "Bruno: a Martyr for Science," and Mr. A. Norman Tate, F.I.C. (one of the vice-presidents) followed with an illustrated lecture on "Water and Ice as Earth Sculptors." On February 9th Mr. A. S. Woodward, F.G.S. (of the British Museum) is announced to lecture on "Modern Ideas of the Creation." The Tyneside Sunday Lecture Society have also devoted several of the meetings to science lectures by men of eminence. The Liverpool Sunday Society alternate an afternoon of music (with full orchestra) with lectures, mostly on science. We note that, on February 16th, Dr. Alfred Russel Wallace will speak on "Darwinism."

THE twelfth social gathering of the Associated Literary, Scientific, and Art Societies of Liverpool was held in St. George's Hall, on the 8th January, and, if not quite so largely attended as on some former occasions, was a great success. Twenty societies were represented on the occasion, and the exhibition of objects displayed in the Great Hall was very large and varied. The principal features were the Littledale trophy, composed of specimens of animals collected expressly for the Liverpool Museum by Mr. St. George Littledale, from the Himalayas, the Caucasus, Rocky Mountains, and other regions; a group of ethnographical specimens from the Mayer museum; a large collection of early books on alchemy and chemistry, exhibited by Professor J. Campbell Brown and Mr. Alexander Watt; large exhibits by the Engineering Society, Geological Association, and Geological Society, and a microscopical exhibition by members of the Liverpool Microscopical Society and Chester Society of Natural Science. The exhibition was also rich in models, not only of fast Atlantic liners, but also of the projected Overhead Dock Railway and the Mersey Bar. Great interest was shown by the visitors in Mr. E. Muybridge's lecture on "Animal Locomotion in Relation to Design in Art," which was illustrated by instantaneous photographs, and that ingenious instrument, the zoopraxiscope. Lectures were also given in other parts of the building by Mr. J. Birchall (one of the honorary secretaries), on "Memorials of Spain under the Moors;" by Mr. C. S. Pain, on "The Vyrnwy Waterworks," by Mr. F. J. Leslie, on "Lancashire Witches," and by the Rev. H. J. Palmer, on "Roman Antiquities in the South of France." The musical part of the *soirée* was well rendered by the Cymric Vocal Union and the Liverpool Opera Society. On the succeeding evening the hall was opened by invitation of the Mayor to the artisans of the city and their wives and friends, when no fewer than 3,000 people assembled to inspect the exhibits of the several societies, and to enjoy the lectures which were again delivered for their benefit.

Foreign Jottings.

ELECTRIC LIGHTING is being pushed forward in many parts of the world, and has even penetrated into Egypt, where electric installations are in progress, not only at Cairo and Alexandria, but on the confines of the desert in Upper Egypt.

CANADA has made a great development in electrical undertakings. One of the largest factories in the Dominion is that of the Royal Electric Company at Montreal, and other companies are also well represented and doing a large business. The readiness with which water power can be made available for electric lighting in the colony is one reason of its general successful adaptation. Around the great falls at Port Arthur, Ontario, a great manufacturing centre is about to arise, and the power obtained from the falls will be distributed electrically to a number of mines in the neighbourhood.

THE SOCIÉTÉ GÉOLOGIQUE DE FRANCE announces the publication, in quarterly parts, of *Mémoires de Paléontologie*, which will be independent of the *Mémoires de Stratigraphie*, and will include not only the lengthy memoirs but also short notes, illustrated with plates. Several works will be in course of publication at the same time, but each of them, when completed, will form by itself a memoir independent of others. The minimum number of plates to be published in a year will be 20. The annual subscription is 20 francs if paid before 1st February, after which it will be raised to 25 francs. The publishers are MM. Baudry et Cie, 15, Rue des Sanits Péres, Paris.

IT is announced that the attempt to acclimatize the reindeer in the Hartz mountains has not proved successful. The experiment is to be tried again at Algan, in Bavaria, where it is hoped that the animals will soon become accustomed to the soil, forage, and conditions of climate, and so create for the peasants in the mountains a new and lucrative branch of industry. The Swedish reindeer are excellent venison, good milk producers, and available as beasts of burden or draught animals.

FROM the *Johns Hopkins University Circular* (Baltimore), we learn that Mrs. Caroline Donovan, of Baltimore, has given the handsome donation of one hundred thousand dollars to the Johns Hopkins University, to be invested by the President and Board of Masters of the Johns Hopkins University, and the annual income thereof to be expended in maintaining a chair of professorship in the said university for instruction in English literature, to be known as the "Caroline Donovan Chair."

SOUNDINGS have been taken in the Pacific Ocean, between British Columbia and Australasia, for the purpose of a projected ocean cable. A depth of 4,530 fathoms was obtained by H.M.S. *Egeria* between Auckland, Tonga, and Samoa, and the survey will probably be continued during the spring and summer months. Direct cable communication between Canada and Australia is a matter of the highest importance, and progress is being eagerly watched by both these great colonies.

AN electro-technical exhibition is to be held from June to October, at Frankfort-on-the-Main, in which, whilst all branches of electrical science will be included, those exhibits which show a decided improvement on those of the last special exhibitions at Munich in 1882, and Vienna in 1883, will have the preference.

ON October 31st, at about 5 a.m., a shock of earthquake was felt at Jæderen, on the south-west coast of Norway. It was also felt in other parts.

IN consequence of the great depredations of seals on fish in Danish water, the Government now offers a reward for every one killed.

THE mails from Iceland report that the weather during the autumn has been mild in the south but stormy in the north. The year has been an excellent one. On October 16th, at 4 a.m., several shocks of earthquake were felt in the Havnefjord, which continued with little intermission until noon. The following nights were also attended with shocks.

DR. T. C. THOMASSEN, of Bergen, has published a review upon earthquakes in Norway, from which we learn the interesting fact that in that country they are far more frequent in winter than in summer, and more frequent in the night than in the day.

BARON M. GEER, the celebrated Swedish geologist, has discovered a so-called "Giant's Bowl" near Strömstad. It is 10 feet in diameter, and has been cleared from *débris* to a depth of 7 feet, but the bottom has not been reached.

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THE Italian Ministry of Agriculture has placed three millions of salmon fry in the lakes Garela, Como, and Iseo, and five millions of eel fry in the lakes near Mantua.

DURING the autumn an enormous quantity of migrating singing birds has struck against the lantern at the top of the Eiffel Tower. One night no less than about a thousand were picked up dead.

IMPORTANT deposits of sponges extending over a surface of from 15 to 18 marine leagues have lately been discovered close to the island of Lampedusa, on the southern coast of Sicily. The sponges are easy to obtain, and the varieties include those which are in great commercial request.

THE chemist of the Russian whaling station at Port Wladimir, on the Murman coast, claims to have been able to produce from whale meat an extract in appearance and taste equal to beef extract.

THE Berlin aquarium has come into possession of a magnificent python *(Pythen biviltatus)* measuring 18 feet in length, and weighing nearly 1 cwt. Contrary to general habit it thrives excellently in captivity, and has a good appetite.

THE expedition despatched from Kiel last spring for the purpose of carrying out researches upon the food of marine animals has returned, having visited Greenland, North America, the Bermudas, Cape Verde Islands, Ascension, and the mouth of the Amazon. It consisted of Professor Hensen, the well-known German ichthyologist, and six *savants*. The result is said to have been important.

A MAXIMUM and a minimum thermometer has been affixed on the hut at the summit of the Galdhöpig, in Norway, the highest mountain in northern Europe, 8,000 feet, through the Meteorological Institute of Christiania. The temperatures will be registered by the mountain guides when opportunity occurs. It is hoped that an observatory like that on Ben Nevis will be established at this altitude, as it would undoubtedly yield interesting scientific results.

Apropos of Dr. Nansen's discoveries in Greenland, the old adage, "there is nothing new under the sun," is again verified, as already 14 years ago the Royal Geographical Society published a kind of Arctic guide for the Nares expedition, in which the Greenland inland ice and nature are theoretically described exactly as Nansen found them.

IN our last issue reference was made to the rising of the shores of the Baltic, and the fall of the water in that basin, and we now learn that in the Gulf of Bothnia the water also falls year by year, whilst the land rises. Thus at Luleå the water has not once since reached the mean level fixed by surveys in 1880, being generally about 2 feet below it. Last year (1889) the average level has been about 8 inches below the mean one fixed in 1880, which should indicate a fall of one inch a year. The subject is being studied most attentively by Swedish and Finnish geologists.

A SUBTERRANEAN RIVER has been discovered in the mountains near Graniat, in the south-west of France. At the bottom of an unexplored gully, 108 metres in depth, a river was encountered, which in a canvas boat was followed for 10 kilometres under the earth, through a number of splendid grottos. Several lagoons were passed. The stream was not followed further, the return journey being made by the aid of oars. It is believed that the stream is a tributary of the Dordogne. This year a thorough exploration of the stream is to be effected.

A MOST remarkable migration of ants is reported in Russian papers from the Government of Cherson. An enormous army of ants moved through the Perujalen forest from south to north in perfect order. The foremost were unencumbered, but the hindmost carried eggs, grain, and straw. On examining the ant-hills in the forest they were found to be empty. In several neighbouring forests similar migrations have been observed. Whither the insects have proceeded has not been ascertained.

A HUNGARIAN MILLIONAIRE, M. Audor v. Semsey, who several times before has made scientific donations, has presented a sum of £10,000 to the Society of Science of Buda-Pesth, to be expended in scientific research.

A ZOOLOGICAL GARDEN has been formed at Shanghai by a Chinese syndicate, the idea being originated by Mr. Carl Bock, the well-known Norwegian traveller in the East.

THE secretary of the American Legation at Pekin, Mr. Rockhill, who, disguised as a pilgrim, had attempted to reach Lhassa, the famous capital of Thibet, has been discovered thirteen days' march from his goal, and, being deprived of everything, was compelled to return. He has now reached Chung-King, on the upper Yang-tse-Kiang, having traversed territory never before visited by European.

IT is stated that Prince Henri of Orleans, eldest son of the Comte de Paris, who is on a journey of exploration in Central Asia, has arrived, with his companion, M. G. Banvalot, the French traveller, at Kuldja, in Chinese Dschungari. In this place he remained for some days with the Russian consul, and then proceeded by the route Gouldoum, Lobror, and Tsaï-Dam, in order to explore the sources of the river Yang-tse-Kiang, believed to be situated in the mountain chain of Tsien-Chan. Next summer the expedition will traverse China to Soukin, when they will have travelled through the whole of the Celestial Empire from north-west to south-east.

AN astronomical clock of great interest is being exhibited at Frankfort. It is made by August Noll, of Schwartzwald, and shows seconds, minutes, hours, weeks, date, month, year, seasons, zodiacs, earth's rotation, and moon's phases up to the year 10,000. It also shows on 17 discs the time in Berlin, Prague, Riga, Vienna, Cairo, Tiflis, Trieste, Rome, Munich, Berne, Geneva, Boston, New York, Paris, Metz, and London. There are also a number of movable figures. The clock is in walnut, in the *renaissance* style, 3·2 metres in height, 3 metres in width, and 1 metre in height. The cost is £1,750.

Apropos of the depth to which light can penetrate into the sea, Professor Herman Fol has published the result of his experiments last summer, effected in the Mediterranean between Corsica and Italy, in very clear water. He employed bromide gelatinous plates, which were exposed for ten minutes. The greatest depth to which light penetrated was 465 metres. This is 100 metres less than the depth reached by the solar rays which the German professors Chun and Petersen found some years ago in the same waters.

Museum Notes.

AN improved label-holder for museums has been invented by Mr. J. J. Ogle. It can be attached readily to the edge of any shelf, whether of plate-glass or any other material; it requires no tacks nor adhesive matter, and is altogether a wonder of simplicity. "Tonks, Limited," of Birmingham, are making it for the Bootle Museum, and, as there is no intention of patenting the invention, any curator may get a supply at a moderate cost from that firm.

THE popularity of the Monday evening "lecturettes" at the Liverpool Free Public Museum continues to be manifested, though, doubtless, if the lectures were more widely advertised, there would be a noticeable improvement in the attendances. During the past month lectures have been given on the following subjects:—"Iron Ores," by Mr. D. Clague, F.G.S.; "The Cockroach," by Mr. G. F. Moore; "Silk and Silkworms," by Mr. Willoughby Gardner; and on "Corals," by Mr. J. B. Warriner.

IN connection with the Geological Association of the same city, the series of monthly visits to the Museum is also continued. The subject of study at the January Museum Meeting—"Contrasts in the Mineral Kingdom"—was ably dealt with by Mr. A. Norman Tate, F.I.C., President of the Association.

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An important gift has been made to the Corporation of Leicester, for their Art Gallery, by Mr. G. F. Watts, R.A., who has presented them with one of his finest pictures, "Orlando Pursuing the Fata Morgana," for the purpose of encouraging and fostering a love of the fine arts.

The Museum Addresses at Bootle are being continued with success. Mr. Councillor Vicars gave an address on "Cuttle Fishes and their Relations," and Mr. Ogle discoursed on "The Structure and Growth of Timber," "Aquaria," and "Extinct Animals." Addresses announced to be given by the popular Chairman of the Committee, Mr. Councillor J. Vicars, have had to be adjourned through his unfortunate illness. We trust he will soon be restored to continue his active work on behalf of the Museum and Free Library.

During the removal and destruction of the walls of the Old Museum, Westgate Road, Newcastle, an interesting memorial has recently been brought to light, and, through the kindness of Mr. C. A. Harrison, C.E., has been presented to the Natural History Society. It is the memorial tablet, made of earthenware, which was affixed to the foundation stone, bearing details of the initial ceremonies, on the 5th day of August, 1833. Of the officers of the society present on that occasion only one now survives, in the person of Mr. John Clayton, of "The Chesters," who was at that time a member of the building committee.

A novel museum has just been constructed in the Victoria Park, Whiteinch, Partick, Glasgow. The structure is of red brick, and about 70 feet long by 30 feet broad. This encloses what may be termed a "natural museum," or grotto, in which are preserved the fossil remnants of the carboniferous "forest" lately discovered on the site. In order that the fossil trees may be seen from all points, a miniature gallery runs down the centre, and from the neat little windows under the verandah spectators can also obtain a good view of the exposed trunks and roots of the ancient relics of vegetation in the Coal Period. It was found that the fossils were likely to be ruined if exposed to frost, and this covering has been erected for their preservation, at the instance of the Partick Burgh Commissioners. The cost of the building is stated to be about £400.

The collections at the Bootle Free Public Museum are being slowly got into proper position by the energetic curator, Mr. J. J. Ogle, notwithstanding the other demands upon his time as librarian, organiser of lectures and teacher of science. The birds are, with few exceptions, definitely arranged, and a handy guide-book to this class is being prepared by Mr. Ogle. This will contain an untechnical account of the chief osteological and other characters of the birds, followed by the ordinal and family characters so far as is necessary for identification. Under each family there will be references to the literature thereon, and, by means of figures and a map, the geographical distribution of the family will be indicated. In the text technical names will be almost entirely discarded, but it is hoped that room may be found in the appendix to give the technical equivalents of the popular names adopted for families and for structural peculiarities, besides an outline of the principal schemes of classification, with indications of the equivalent divisions in the classification followed in the guide-book.

The Rounding and Isolation of Rock-Masses.

By Cecil Carus-Wilson.

The remarkable roundness of some of the weathered blocks seen on granite tors, and in sandstone and other districts, resulting often in the formation of "rocking-stones" and masses resting upon slender pedestals, has lately been occupying my attention, and has resulted in a conviction respecting the origin of their outline which I have not heard suggested before.

Let it be granted that a given block of rock be separated from the main mass either by joints, planes of bedding, or a combination of the two, then the usual atmospheric agencies of denudation will tend to enlarge the spaces and eventually isolate the rock, and leave the base as the only point of contact.

At this stage one would expect the base of the block—which might be a part of the original plane of bedding—to be more or less protected from the action of atmospheric denudation by its mass above and the bed upon which it rested; but, as a matter of fact, this point of contact seems too often to be the one which succumbs most readily to the influence of the weather, and hence we have a large rounded block resting on a very slender base.

Now, why should the base of the block wear away more rapidly than the top or sides?

The reason is, I think, that the rain water becomes concentrated at the point of contact, and is retained there for a longer period than at the top or sides, and hence the process of chemical and mechanical disintegration progresses with greater rapidity at the base than at any other part of the stone. When rain falls upon the stone some will be evaporated, some will soak through to the base, while by far the largest quantity will run round the surface, and be finally carried off at the point of contact.

I have frequently observed after rain that this point of contact retains its moisture for a considerable time after the top and sides of the block have become dry; and hence this point of extreme concentration, or saturation, would be liable—in the case of granite—to a more rapid kaolinization of the felspar, and, in the case of sandstone, to a more rapid dissolution of the mineral cements, resulting in the production at the base of a greater rapidity of disintegration.

I think in this way a huge mass may be gradually lowered without any appreciable movement, or finally so undercut as to roll off to some lower level.

Additions to the List of the Plants of the Isle of Man.

By the Rev. Samuel Gasking, B.A., F.G.S.,

Corresponding Member of the Isle of Man Natural History and Antiquarian Society, Member of Council of Liverpool Naturalists' Field Club, &c.

Order 1.—*Ranunculaceæ.*
Ranunculus aquatilis—Water crowfoot.
r. 6.—Baudotii.
Do. auricomus—Goldilocks.

Order 4.—*Papaveraceæ*
Chelidonium majus—Celandine.

Order 6.—*Cruciferæ.*
Coronopus Ruelii—Common wart-cress.
Draba verna—Common whitlow grass.
Cardamine hirsuta—Hairy bitter-cress.
v. 2.—Sylvatica.
Barbarea vulgaris—Winter cress.
Sisymbrium thalianum—Thale cress.
Brassica napus—Rape.
Do. rapa—Turnip.
Raphanus raphanistrum—Wild radish.

Order 9.—*Violaceæ.*
Viola odorata—Sweet violet.

Order 10.—*Droseraceæ.*
Drosera intermedia—Long-leaved sundew.

Order 14.—*Caryophyllaceæ.*
Lychnis Githago—Corn-cockle.
Sagina subulata—Awl-shaped pearl-wort.
Do. nodosa—Knotted do.
Spergularia marina—Sea-side sand-wort
spurrey.
C. rupestris.
Stellaria nemorum—Wood stitch-wort.
Cerastium semi-decandrum—Little mouse-ear chick-weed.

Order 17.—*Tiliaceæ.*
Tilia grandiflora—Broad-leaved lime.

Order 19.—*Aceraceæ.*
Acer campestre—Common maple.

Order 25.—*Leguminosæ.*
Ononis spinosa—Spiny rest-harrow.
Medicago lupulina—Black medick.
Trifolium striatum—Soft-knotted trefoil.
Do. filiforme—Slender yellow do.
Vicia Orobus—Wood bitter-vetch.
Do. sepium—Bush do.
Do. hirsuta—Hairy tare.
Lathyrus tuberosus—Earth-nut pea.

Order 26.—*Rosaceæ.*
Prunus avium—Wild cherry or gean.
Rubus Lindleianus—Lindley's bramble.
Do. rhamnifolius—Buckthorn-leaved do.
Do. incurvatus—Curved do.
Do. discolor—Two-coloured leaved bramble.
Do. leucostachys—White-clustered do.
Do. Selteri—Salter's do.
Do. villicaulis—Pilose-stemmed do.
Do. Lejeunii—Lejeune's do.
Do. Althæifolius—Marsh-mallow-leaved bramble.
Rosa mollissima—Villous rose

Order 27.—*Onagraceæ.*
Epilobium hirsutum—Great hairy willow-herb.
Do. tetragonum—Square-stalked do.

Order 28.—*Halorageaceæ.*
Myriophyllum verticillatum—Whorled water-milfoil.
Do. spicatum—Spiked do.
Do. alterniflorum—Alternate-flowered do.
Callitriche verna—Vernal water star-wort.
Variety 2.—*Platycarpa.*
Do. hamulata.

Order 34.—*Scleranthaceæ.*
Scleranthus annuus—Annual knawel.

Order 37.—*Saxifrageæ.*
Saxifraga granulata—White meadow saxifrage.
Parnassia palustris—Grass of Parnassus.

Order 40.—*Umbelliferæ.*
Helosciadium inundatum—Least marsh-wort.
Ægopodium podagraria—Bishop-weed.
Pastinaca sativa—Wild parsnep.
Torilis nodosa—Knotted hedge parsley.
Myrrhis odorata—Sweet cicely.

Order 43.—*Rubiaceæ.*
Galium cruciatum—Mug-wort.

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List of Plants—*Continued.*

Order 44.—*Valerianaceæ.*
Valerianella olitoria—Lamb's lettuce. ✓

Order 46.—*Compositæ.*
Leontodon hispidus—Rough hawkbit. ✓
Sonchus asper—Common sow-thistle. ✓
Hieracium umbellatum—Narrow-leaved hawkweed.
Taraxacum officinale Dandelion.

Variety 1.—*Dens-leonis.*
Cichorium Intybus—Common succory.
Carlina vulgaris—Carline thistle.
Centaurea scabiosa Great knapweed.
Senecio aquaticus—Marsh ragwort. ✓
Inula Helenium—Elecampane.

Order 47.—*Campanulaceæ.*
Campanula latifolia—Giant bell-flower.

Order 48.—*Ericaceæ.*
Erica cinerea—Fine-leaved heath.

Order 51.—*Apocynaceæ.*
Vinca minor—Lesser periwinkle.
Do. major—Great do.

Order 56.—*Scrophulariaceæ.*
Veronica officinalis—Common speedwell.
Variety 2. *Hirsuta.*
Do. hederifolia Ivy-leaved do.
Do. agrestis—Field do. ✓
Linaria Elatine—Sharp-leaved fluellen.

Order 59.—*Labiatæ.*
Mentha arvensis Corn mint
Calamintha acinos—Common basil thyme.
Do. officinalis Common calamint.
a. Menthifolia.
Lamium incisum—Cut-leaved dead-nettle.
Marrubium vulgare—White horehound.
Scutellaria galericulata—Common skull cap.

Order 60.—*Boraginaceæ.*
Lycopsis arvensis—Small bugloss.

Order 66.—*Chenopodiaceæ.*
Chenopodium murale—Nettle-leaved goose-foot.
Do. rubrum—Red do.
Do. Bonus Henricus—Good King Henry.
Atriplex hastata—Halberd-leaved orache.
b.—Deltoidea. ✓

Order 67.—*Polygonaceæ.*
Polygonum amphibium—Amphibious bistort.
Do. hydropiper—Biting persicaria.
Rumex obtusifolius—Broad-leaved dock.
Do. hydrolapathum—Great water do.

Order 73.—*Euphorbiaceæ.*
Euphorbia paralias Sea spurge.
Do. lathyris—Caper do.

Order 78.—*Salicaceæ.*
Salix repens—Dwarf silky willow.
Do. viminalis—Osier.

Order 81.—*Orchidaceæ.*
Epipactis palustris—Marsh helleborine. ✓

Order 89.—*Alismaceæ.*
Triglochin palustris—Marsh arrow-grass.

Order 90.—*Naiadaceæ.*
Potamogeton pusillus—Small pond weed.
Do. perfoliatus—Perfoliate do.
Do. polygonifolius—Polygonum-leaved do.
Zannichellia palustris—Horned do.

Order 91.—*Typhaceæ.*
Typha latifolia—Great bulrush.

Order 95.—*Juncaceæ.*
Juncus nigrescens—Lesser-jointed rush.
Do. compressus—Round-fruited do.
c. 2.—Gerardi.

Order 96.—*Cyperaceæ.*
Isolepis fluitans—Floating mud rush
Eleocharis palustris—Creeping spike rush
Do. caespitosa Deers' hair.
Do. acicularis—Least spike rush.
Carex acuta—Slender spiked sedge.
Do. glauca—Glaucous heath do.
Do. panicea—Pink-leaved do.
Do. praecox—Vernal do.
Do. obtusa—Long bracteate do.

Order 97.—*Gramineæ.*
Phalaris arundinacea Reed canary grass
Anthoxanthum odoratum—Sweet vernal do
Phleum pratense—Common cat's tail do.
Alopecurus geniculatus—Floating fox tail do.
Agrostis canina—Brown bent do.
Do. alba Marsh do. do. ✓
Arundo phragmites—Common reed. ✓
Aira caespitosa—Tufted hair-grass.
Do. cæspitosa—Silver do. ✓
Do. praecox—Early do. ✓
Avena pratensis—Narrow-leaved oat-grass.
Holcus mollis—Creeping soft grass. ✓
Triodia decumbens—Decumbent heath grass. ✓
Melica uniflora—Wood melic grass.
Molinia coerulea—Purple molinia.
Catabrosa aquatica—Water whorl grass
Glyceria fluitans—Floating meadow grass.
Schlerochloa maritima—Sea meadow grass.
Do. rigida—Hard do.
Poa trivialis—Rough do. ✓
Briza media Common quaking grass. ✓
Festuca ovina—Sheep's fescue grass. ✓
c. Rubra.
Bromus asper—Hairy brome grass.
Do. sterilis—Barren do.
Do. mollis Soft do.
Triticum junceum—Rushy wheat grass.
b. Acutum.

Order 101.—*Equisetaceæ.*
Equisetum palustre—Marsh horse tail.
Do. variegatum Variegated do.

Order 102.—*Characeæ.*
Chara vulgaris—Common chara. ✓

Corrections.

Helianthemum guttatum—spotted annual rock rose.

It is upon record that this plant was discovered in sandy fields in the Isle of Man, about 60 or 70 years ago. It is a very rare plant. *H. Guttatum* proper has the pedicels ebracteate, and occurs at Cork, Jersey, and Alderney. The sub-species *H. Breweri* has the pedicels bracteate, and is to be seen growing at Holyhead and Anglesey. The Manx form, therefore, may be found to correspond with the latter. It is to be hoped that diligent search may be made for this interesting plant.

Silene acaulis—moss campion.

Saxifraga oppositifolium—purple mountain saxifrage.

Both of these are mentioned in "Black's Guide" as having been found in the island. Evident errors inseparable from guide books. *Chrysosplenium oppositifolia*, the common golden saxifrage, is very abundant.

Ulex nanus—dwarf furze.

This should have been entered on my list as *Ulex nanus. V. 2—Gallii.* Although this plant assumes a variety of forms on account of its different situations, it can, in no state, in which it may be seen, be mistaken for *U. nanus* proper, which is a plant only found growing in the South of England. The Manx form is undoubtedly "Gallii," as it was identified by Professor Babington himself when on a visit to the island.

Note.—The Rubi have been inserted on the authority of Professor Babington. My thanks are again due to Mr. R. Brown, the Botanical Referee of the Liverpool Naturalists' Field Club, for help in naming critical specimens; also to Mr. F. R. Chalmers, who collected for me during September a number of plants and sent them over for examination.

Societies and their Work.

"MODERN PHOTOGRAPHY" was the subject of a paper recently read before the Belfast Natural History and Philosophical Society by Dr. Cecil Shaw, who, after dealing with the chemistry of the art, referred to the number of scientific uses to which photography is now put, observing that it would be hard to mention any profession or business in which it is not at times useful. Both the legal and medical professions were indebted to it; it was useful for military purposes; and to the artist, as well as to the astronomer or the antiquary, the biologist, and the geologist. In another paper, Mr. R. L. Praeger, B.E., detailed a scheme for a proposed memoir on the "Vertebrate Fauna of Ulster," in which all interested in the study of local natural history are invited to join. An instructive discourse was also afforded to the members of this society by Mr. Mr. C. Herbert Waddell, who, in his "Notes on Plant Life," explained the properties of chlorophyll and the functions of plant cells. A cognate subject, "The Cells of Mosses," was effectively treated by the Rev. W. H. Lett, who traced the growth of a moss from a spore up to the simplest fruit-bearing plant. The Belfast Natural History Society was founded in 1821, and has steadily grown since its inauguration. It possesses a very creditable museum of its own in College Square, Belfast.

At the December meeting of the Conchological Society of Great Britain (held in Manchester) Mr. Cosmo Melvill read a paper on the "Pioneers in Conchology during the last two hundred years." Among the many exhibits shown on this occasion perhaps the most curious was that of Mr. J. K. Hardy, who displayed two interesting specimens of *Clanculus pharonis*, found in the breast decoration of an Egyptian mummy. At the January meeting Mr. J. C. Milne read a paper on the land and fresh-water mollusca of Achill Island, in which he embodied the results of his collecting there during the summers of 1886 and 1888.

The preparation and mounting of insects in Canada balsam has been much discussed. Mr. M. L. Sykes, of the Manchester Microscopical Society, condemns the pressing out of the contents of the body, as thereby the internal structure is lost. He recommended bleaching the insect in a dilute solution of chlorinated soda, mounted afterwards with slight pressure.

"Agricultural Experiments" was the subject of a useful lecture delivered by Mr. Edward Kinch, F.C.S., before the Chester Society of Natural Science. He described the Rothamsted experiments in the growth of cereals, leguminous plants, roots, grasses, &c. The various departments of this large society are now in full working order. Mr. G. E. Thompson showed to the Photographic Section a series of over 100 views taken by him in Normandy in August last. The new section devoted to Literature opened with a paper by Mr. E. J. Baillie, on "John Ruskin." Mr. G. P. Miln gave an elaborate paper on "Leguminous Plants" to the Botanical, and Mr. Cowan contributed a paper on "Some Applications of Magnetism" to the Applied Science Section.

Dr. F. C. Larkin, of University College, Liverpool, gave an address to the Science Students' Association of that city on "The Face: its Structure and Development," illustrated by a large series of drawings and wax models of embryos, showing also the formation of hare-lip, cleft-palate, and other congenital deformities. The specialising of the head from the folding in of the anterior end of the blastoderm, the dilatations or swellings of the head, and the formation of such organs as nose, eyes and ears, and the development of the mouth, were traced out. In connection with the branchial or gill clefts, present during certain stages, the lecturer pointed out that these are of universal occurrence in the development of the vertebrate group of animals.

Two societies devote themselves to the "stony science" in Liverpool. At the Geological Society, Mr. L. Cumming, M.A., detailed some observations of his own on the subject of "Glacial Moraines," drawn from several visits to Norway, Switzerland, and Austria. His observa-

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tions had some bearing also upon the glacial phenomena as seen in Lancashire and Cheshire.

The Coal Measures of Lancashire are well developed around St. Helen's, and in a paper dealing with that neighbourhood, read before the Liverpool Geological Association, the Rev. S. Gasking, F.G.S., gave a careful account of the physical and stratigraphical characters of the different beds known to occur in this area.

The members of the Manchester Architectural Association are nothing if not practical. The Doulton Pottery Works at Lambeth were minutely described at a recent meeting, whilst, on another occasion, the more professional matter of "Architects' Commission" was the subject of a vigorous discussion. Mr. Lawrence Booth's argument was mainly directed against the principle of payment by commission, or the regulation of the remuneration of architects by the amount of money spent.

During the past two years the Historic Society of Lancashire and Cheshire seems to have taken a new lease of life, and the number and good quality of the papers brought before it promises well for the future. At the annual meeting, held on January 16th, it was announced that 62 new members had joined during the year, and that two illustrated volumes of the *Transactions* had been issued.

The value of the work done by the Hull Geological Society has been shown by the successful results of the society's operations. In addition to the ordinary monthly meetings and excursions, members are admitted to the meetings of the Hull Field Naturalists' Society, and have also the privileges of associates of the Yorkshire Naturalists' Union, and the *entrée* of the Museum of the Royal Institution. At the January meeting, Mr. Alfred Harker, F.G.S. (of St. John's College, Cambridge), read a paper entitled "Chapters in the Geological History of East Yorkshire." He instanced, in the district around Holderness, several problems of interest which still remained for solution. The syllabus of the society for the present session is an attractive one. At the forthcoming meetings the Rev. H. E. Maddock will lecture on "Flint," and Mr. S. A. Adamson on "The Work of the Yorkshire Boulder Committee."

The opening meeting of the second session of the Warrington Field Club was held on the 13th January in the Museum Lecture Room, the proceedings taking the form of a public lecture by the Rev. Joseph Freeston, of Macclesfield, the subject being "Flowers: their Forms and Structure." The flower models used were those of the stock, sweet pea, ox-eye daisy, and dock, with models also of a grain of wheat, capsule of moss, and germinating acorn.

Reports of Societies.

Biology and Natural History.

Birmingham Microscopists' and Naturalists' Union.—On December 9th Mr. Cardwell read a paper on "Domestic Bird Life," in which he mentioned a number of birds he had kept in confinement, and the many points of interest he had observed in their modes of pairing, nest building, feeding, and treatment of their young. It is often said the pigeon will not hatch out eggs other than its own, but the writer noticed that they would generally hatch the eggs of other individuals. Parent birds, he was convinced, paid special attention to feeding the young of their own sex. Previous to emerging from the eggs he was of opinion that the young birds did not break the shell by repeated blows, but by scraping it with the point of the beak, so that it readily fractured in a certain direction. Subsequent meetings on 16th and 23rd December were devoted to miscellaneous exhibitions of objects of natural history, the meeting on 13th January being devoted to "Practical Microscopy," when a number of interesting slides and microscopical preparations were shown.

Clydesdale Naturalists' Society.—The fourth meeting of this society was held at 207, Bath Street, Glasgow, on Wednesday evening, 18th December, Mr. R. J. Bennett, vice-president, in the chair. Mr. D. C. Glen, F.G S., exhibited a series of humming birds' nests and eggs from Brazil, and made some remarks on the habits of these little creatures, at once, perhaps, the smallest and most beautiful of all the families of the feathered world. One of the nests had been built on a piece of raw hide, which had been used in tying up a fence. Mr. Robert H. Read, C.E., gave an interesting account of the habits of the cuckoo (*Cuculus canorus*), and exhibited a number of the eggs of that "herald of spring." In the north the cuckoo generally lays in the nest of the meadow pipit, but in Northumberland and other parts of England its eggs have been found plentifully in the nests of the whinchat, and also in those of the hedge sparrow, rays, wagtail, &c. He also showed eggs of the great spotted cuckoo (*Cuculus glandarius*), which has twice appeared in this country, pale green spotless eggs of the redbreast, and ten distinct varieties of the eggs of the tree pipit (*A. trivialis*). The variation of these was something remarkable. Mr. John M. Bertram laid on the table eggs of the chipping sparrow (*Fringilla socialis*) and the cow bunting (*Emberiza pecoris*), natives of America. The latter adopts the same method as the cuckoo, *i.e.*, drops its eggs into the nests of other birds and leaves them to the mercy of their foster-parents. Mr. Alfred Brown read a paper on "Balls of *Cladophora glomerata*, from Lower Kildonan Loch, South Uist." These curious objects are scattered all over the bottom of this small loch in South Uist, but they have not been found in any other part of Britain, although they have been reported from some lakes on the continent. They are more plentiful in the shallower portions of the loch, and where the Roglass Burn makes its exit. On examination they are found to be composed externally of a sort of matted felt, consisting chiefly of a filamentous alga, *Cladophora Œgagrophila* (*var. glomerata*), and internally of loose broken fragments of the same alga, along with mud, sand, and diatoms in varying proportions. The algæ forming the outside of the balls are, when collected, living, and show signs of producing spores, while those inside appear to be dead. Scientists have not yet given any satisfactory explanation of the origin of these balls, but Mr. Brown is of opinion that they are caused by the mechanical action of the waves, the loch being a very shallow one. Mr. Robert J. Bennett read a paper entitled "Apiarian Notes in Argyleshire, in 1889." Although not so disastrous as 1888, the past season has not done much for bee-keepers, this being attributed to the remarkably short time which the heather was in bloom, and to the heavy rains during July. From Wigtownshire alone have anything like favourable reports been received, all over the West of Scotland the yield of honey being very much below the average.

Lancashire and Cheshire Entomological Society.—At the annual meeting of this society, Mr. S. J. Capper, the re-elected president, gave his thirteenth annual presidential address, in which he reviewed the history of this flourishing society since its inauguration, afterwards referring to the chief entomological events of the past season, which, for the lepidopterist, has been but "a very ordinary one." In economic entomology there has not been recorded any widespread injurious insect attack, except the devastations of orchard pests. Serious injury has been done to the linen manufacturing industry in the north of Ireland by certain larvæ, which were found to gnaw holes in the linen during the process of bleaching. These depredations, at first attributed to *Arctia fuliginosa*, were really caused by the common species of the genera *Triphæna* and *Noctua*, which, impatient of confinement, gnawed the holes to obtain freedom and food. Another point of the year's advance has been the increased co-operation for a prevention of warble attack. Whilst certain of our insect enemies have disappeared, some new appearances are noted. Among foes to fruit growers the boring beetle, *Xyleborus*

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dispar and the *Pulvinaria*, which infests all kinds of currants, have been recorded. Sugaring in the New Forest was not so successful during the early part of the season, few insects being attracted. The address of Mr. Capper (which will appear in the *Proceedings*) covered a wide extent of ground, and forms an excellent *resumé* of entomological progress during the year 1889.

SHEFFIELD NATURALISTS' CLUB.—On December 4th Mr. A. H. Bemrose, F.G.S., delivered a lecture on "Volcanoes." After pointing out the early erroneous ideas of volcanoes he gave a description of the forces at work in producing volcanic action, illustrating his remarks with excellent views of Stromboli, Vesuvius, and Solfatara. Mr. Bemrose had carefully inspected certain regions of extinct volcanoes in Germany, France, and England, and gave a detailed description of the various volcanic rocks, calling special attention to the lava underlying the mountain limestone in Derbyshire, and showed how the rock structure is influenced by the rate of cooling.——On December 13th the annual *conversazione* of the club was held, when there was a varied and instructive exhibition of objects of natural history. Dr. H. C. Sorby, F.R.S., exhibited a very interesting series of marine animals mounted on glass, which he had prepared as lantern slides and museum specimens, including medusæ, nudibranchs, annelids, starfishes, &c., and by this method the structure of the animals could be well seen. Mr. A. T. Watson exhibited some living ascidians and other living objects under microscopes, while Professor Denny, F.L.S., of Firth College, showed some embryos of fowl and frog in various stages of development, and Mr. C. Bradshaw, F.C.S., assistant in the museum, showed some sections of igneous rocks under the microscope. Mr. E. Howarth, F.R.A.S., in his presidential address, referred to the work done by the club during the year, and suggested that those members of the club who possessed photographic cameras should utilise them next year in photographing objects of geological interest that might be visited in the course of the excursions. He then called attention to some of the results of astronomical photography, showing by means of the lantern some photographs of the moon, stars, and nebulæ, six of which had been taken from prints recently presented to the museum observatory by Mr. Isaac Roberts, F.R.A.S. Later in the evening Professor Denny gave a description, illustrated with lantern views, of the life history of a liver fluke, taking for his subject the fluke so destructive in the disease known as "sheep rot." The curious larval forms and their methods of development were clearly explained by Professor Denny.

Geology.

GEOLOGICAL SOCIETY OF LONDON.—On December 18th the following papers were read:—"On the Occurrence of the Genus *Girvanella*, and Remarks on Oolitic Structure," by E. Wethered, F.G.S. The author showed that *Girvanella* as a rock-forming organism is more important than was supposed, occurring in the Gloucestershire pea-grit and the coralline oolite of Weymouth. "On the Relation of the Westleton Beds of 'Pebbly Sands' of Suffolk to those of Norfolk," Part II., by Professor J. Prestwich, F.R.S. In this paper, the author having previously discussed the relationship of the Westleton beds to the crag series and glacial deposits, proceeded to consider their extension inland, beyond the area of the crag.——At the meeting on 8th January, Mr. A. S. Woodward, F.G.S., read a communication on "Some Jurassic Fish Remains Referable to the Genera *Eurycormus* and *Hypsocormus*." The fossils described have been lately discovered in the Oxford and Kimmeridge Clays of England, and were of value in the precise determination of certain skeletal features in the genera to which they belong. Professor C. Lloyd Morgan, F.G.S., read an elaborate paper on "The Pebidian Volcanic Series of St. David's," which he treated in three main divisions, viz:—The relation of Pebidian to Cambrian; the Pebidian succession; and the relation of the Pebidian to the Dimetian. The paper gave rise to a lengthy discussion, in which Dr. Hicks, Professor McKenny Hughes, and other well-known controversialists in the Archæan arena took part.

LIVERPOOL GEOLOGICAL SOCIETY.—The usual evening meeting of this society was held on Tuesday, Jan. 14th, at the Royal Institution. The president, Dr. C. Ricketts, F.G.S., described an interesting section of boulder clay at Seacombe, enclosing vegetable mould. Mr. W. H. Miles exhibited some curious cylindrical masses of sandstone, cemented by oxide of iron, from near Prenton. Mr. T. Mellard Reade, C.E., F.G.S., exhibited some sand from the sandhills at Crosby, stained red locally in the neighbourhood of fragments of iron. Mr. Linnæus Cumming, M.A., read a paper entitled "Notes on Glacial Moraines," in which he gave an account of the observations he had personally made on the subject during numerous visits to existing glaciers in Norway, Switzerland, and Austria. Commencing with the origin of the moraine stuff, he called special attention to the very large quantity of fine material, consisting of minute angular fragments, which were present throughout a great part of the mass of the ice, and which was very noticeable whenever a small portion of glacier ice, however pure in appearance, was allowed to melt in the mouth. This fine material accumulated on the surface of the glacier, near its lower end, by the process of melting out. The origin of this material, as well as of the accompanying larger blocks, was attributed to disintegration of exposed rock surfaces on the sides of the valley or in the ice-field by the action of variations of temperature, frost, and wind. The formation of the various forms of crevasses, by means of which the moraine matter was admitted to the body, and often ultimately to the bottom, of the glacier was then described. Transverse crevasses, formed on the convex side of the glacier at a curve in the trend of the valley; oblique crevasses, due to differential motion of the centre and sides of the glacier; and longitudinal crevasses, due to variation in the depth of a portion of the bed, were referred to. It was suggested that possibly the streams which exist under glaciers wear out a hollow in the bed, and that the central parts of the glacier settling into such a hollow might not only be a cause of longitudinal crevasses, but might also account for the fact that the lateral moraine bands on the glacier were not at the edges, but some little distance therefrom. The radiation from the dark sides of the valley causes the ice mass to melt more rapidly there, so that a space is formed between the side of the glacier and the side of the valley. The curious result, that, while very large and very small pieces of stone lying on the ice protected the ice below from melting so rapidly in the sun's heat, intermediate-sized pieces accelerated the melting, was referred to and explained. The moraine material, having reached the end of the glacier, either accumulates as a large terminal moraine when the glacier is advancing or stationary, or is more or less distributed by the glacier streams. Mr. Cumming referred to the very great rarity of scratched and polished stones in the glacier moraines, the fact being that the material composing the moraines is remarkable for its angular character. Finally, with reference to the glacier theory of rock-bound lake basins, he remarked that in the case of none of the numerous existing glaciers he had visited had he observed anything like a rock basin at or near the termination of a glacier, though, of course, this fact could not be taken to prove that that theory was not correct, or that such modern rock basins might occur. Mr. T. Mellard Reade followed with a short note on a boulder found while driving a sewer heading in Addison Street, specially describing observations made on the large boulder before it was disturbed from its position in the clay. After some discussion votes of thanks to the authors of the papers concluded the proceedings.

YORKSHIRE NATURALISTS' UNION: GEOLOGICAL SECTION.—The sectional work during the past year has been most satisfactory; the field excursions have been well selected as to locality, and the good

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attendance of members and associates proves that they have been highly appreciated. The first excursion was to that wild and romantic moorland district lying south-west of Holmfirth, and was ably conducted by Mr. Joseph Field, of Huddersfield. The configuration of the country around, the succession of the beds, and some remarkable examples of denundation were noted. The second excursion was once more to that classic region, the Peak and Robin Hood's Bay. Under the able direction of Mr. W. H. Hudleston, F.R.S., and the Rev. E. Maule Cole, M.A., the members on this day had a favourable opportunity for studying portions of the lias and inferior oolite. The third excursion was to the locality north and north-west of Harrogate by a circuitous route through Ripley, Clint, Hampsthwaite, and by Four Lane Ends and Birk Crag back to Harrogate. On this day were seen to great advantage the lower magnesian limestone (Permian) and the millstone grits and Yoredale rocks (Carboniferous). The remarkable outlier of magnesian limestone, forming the boss of Nidd rock, also the highly fossiliferous Cayton Gill beds at Clint, were closely examined. This excursion was not formally under a leader, but during the day an address upon the geology of the district, describing each bed in detail, and localities for sections, was given at Hampsthwaite by one of the sectional secretaries (Mr. S. A. Adamson, F.G.S.) The fourth excursion was to Upper Teesdale, where the members had a splendid opportunity of studying that remarkable example of ancient volcanic activity in the extreme corner of our county, known as the "Whin Sill," and also of viewing the majestic and impressive scenery of the district. This excursion extended over three days instead of one. On the first and second the bank of the Tees was traversed on the Durham side by Widdy Bank and Falcon Clints to Caldron Snout, returning on the Yorkshire side by Cronkley Scars and the Old Pencil Mill to High Force. On the third day Messrs. Ord and Maddison's whinstone quarries were visited, and also Fairy Dell, Holwick Scars, &c., under the experienced leadership of Major Bainbridge. The fifth excursion was to Kirkham Abbey for Acklam Brow and vicinity, under the genial leadership of the President of the Section (Rev. E. Maule Cole, M.A.), Sections at Westow, Leavening, &c, in the oolitic and cretaceous rocks were visited and closely examined. The members may also be congratulated upon the fact that four of the Committees for Special Research connected with the Union owe their existence and continuance of operations to the Geological Section, viz :—The Yorkshire Boulder Committee, the Yorkshire Fossil Flora Committee, the Yorkshire Coast Erosion Committee, and the Yorkshire Geological Photography Committee. Such important committees doing yearly good work upon special lines speak well for the energy and persevering application of Yorkshire geologists.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between December 16th and January 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	....Highest (December 26th)	30·55	Inches
,, ,,	....Lowest (January 5th)	29·35	,,
,, ,,	....Mean	30·032	,,
,, ,,	.... ,, for 22 years December	29·860	,,
,, ,,	.... ,, ,, January	29·910	,,
Temperature	..Highest (January 6th)	56·2	Deg. F.
,,	..Lowest (January 2nd)	22·5	,,
,,	..Mean	43·0	,,
,,	.. ,, for 22 years December	39·8	,,
,,	.. ,, ,, January	39·1	,,
,,	.. ,, of Evaporation	40·9	,,
,,	.. ,, ,, for 22 years December	38·1	,,
,,	.. ,, ,, ,, January	37·4	,,
(*b*) Rainfall	.....Amount	2·502	Inches.
,, ,,	..... ,, Mean for 22 years December	2·672	,,
,, ,,	..... ,, ,, ,, January	2·239	,,
,,	.....Number of Days on which Rain fell	20	
,,	.....Greatest fall in 24 Hours (December 19th)	0·488	Inches
Cloud	.....Mean Amount (0 indicating clear sky, 10 overcast)	7·7	
,,	..... ,, ,, for 22 years December	6·9	
,,	..... ,, ,, ,, January	7·1	
(*c*) Wind	.....Velocity, Greatest (January 14th)	62	Miles.
,,	..... ,, Least (December 29th)	2	,,
,,	..... ,, Mean Hourly	19·6	,,
,,	.....Greatest Pressure on Square Foot (Jan. 14, 8-55 p.m.)	48·8	Pounds.
,,	.....Direction at time of Greatest Pressure	SW	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
0	33	199	157	202	145	8	0	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed one foot above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

THE WEATHER.

December 15, 1889, to January 14, 1890.

During the third week of December the barometric pressure continued very unsteady, and temperature varied from 49° to 36·6°, with more or less rain every day. The means :—Barometer 30·08 in. ; mean temperature 41·46° ; humidity 95% ; total rainfall 1·645 in. ; sunshine 0 hours 40 minutes ; prevailing wind W. On the 25th the barometer rose to 30·46 in., and continued high and fairly steady to the close of the month ; temperature from the 27th became the season—dry and frosty—and afforded skaters some enjoyment during the holidays. Means :—Barometer 30·181 in. ; temperature 38·43°—the last four days only 32·7° ; humidity 92·6% ; totall rainfall 0·707 in. ; sunshine 1 hour 55 minutes ; wind variable.

The month of December was on the whole mild, with frequent fogs and many wet and gloomy days. The mean pressure, 30·137 in., was 0·25 in. above the average, with wide range, and 21 oscillations. The mean temperature, corrected for daily range, 37·93°, although 3° below last December, is the local average value. Frost occurred on 13 days. The humid and calm state of the atmosphere prevented much sunshine being recorded—only 9 hours 35 minutes, or 4·3% of time between sunrise and sunset, the least monthly amount recorded during the last four years. Rain fell on 18 days to a total of 4·197 in., which is about the average. Snow fell on the 6th and 11th, but disappeared again the same days ; hail on the 21st ; graupel on the 11th ; glatties on the 8th ; hoar frost on eight days ; and fog on 14 days.

During the first week of January the weather was variable with wide range of temperature, the mean on the 3rd being 27·18°, and on the 7th 51·2°, with a mean for the week of 39·88°. The frost broke up on the evening of the 3rd with drizzling rain, producing *glatties* to such an extent as to make locomotion difficult and dangerous during the night. A "fresh" breeze blew from the South during the night of the 6th and till noon on the 7th. Means :—Barometer 29·918 in. with wide range ; humidity 90% ; total rainfall 0·580 in. ; sunshine 1 hour 15 minutes ; wind S. and E. From the 8th to the 14th the barometer made repeated oscillations, but with slight range ; temperature equable and above the average ; weather brighter. Means :—Barometer 30·044 in. ; temperature 43·44° ; humidity 90% ; total rainfall 0·874 in. ; sunshine 8 hours 25 minutes ; wind variable.

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Review of 1889.

Bolton Meteorological Observatory.

Chadwick Museum, January 1st, 1890.

To the Chairman and Committee of the Park, Museum, and Burial Board.

In taking a review of the meteorology of the year there are some points of satisfaction to refer to. First in importance is temperature; and here we find that during the months from March to October the means were either above the average or above those of the two preceding years, while we experienced none of the extremes of heat or cold, the warmest day, 65·98°, occurring on the 31st July, and the coldest, 26·38°, on the 10th February, the mean for the year being 46·61°. Of sunshine, in March, June, and July there was above the average amount, while in August only 73 per cent. of the four years' average. The amount of precipitation and evaporation, if we leave out the period of absolute drought which took place from the 14th June to 6th July, has been equally distributed through the year; at no time has the rainfall been so heavy as to cause floods or seriously damage growing crops, the two heaviest falls being 1 in. on July 12th and 1·03 in. on August 14th. The many wet days (24) during August was tantalising to agriculturalists, and retarded the harvest considerably. The total rainfall of the year, 39·895 in., although about 4 in. below the average, was 12·35 in. above that of 1887, and near 2 in. in excess of 1888. Wind:—With the exception of gales on the 2nd, 3rd, and 8th of February, March 20th, and October 7th the currents of the air have been light. The mean daily distance traversed is 16 per cent. less than 1888 and 12 per cent. less than 1887, while the number of days registered "calm" or "W" is decidedly above the average. Electrical disturbances have not been so numerous as in 1888, nor, if we except the storms which occurred on Sunday, the 2nd June, have they been severe. On 18 occasions observations in conformity with the instructions of the Committee on Thunderstorms appointed by the Royal Society have been recorded and sent on to the secretary.

The following table gives the year's accumulations of the amount of growing temperature, rainfall, and bright sunshine:—

Year.	Growing temp.	Rainfall.	Sunshine.
1887	41°389°	27·546″	1132 hrs. 32 min.
1888	41°543°	37·985″	786 hrs. 57 min.
1889	42°735°	39·895″	835 hrs. 13 min.

It should be borne in mind, in reference to the temperature and sunshine of 1887, that their potency for good as factors in growth was in a great measure inoperative through the deficiency in rainfall, while in 1889 the three factors were in a more normal state. The autumn and early winter months have been favourable to both agricultural and horticultural prospects, and there is promise of a more abundant year in store for us.

W. W. Midgley, F.R.Met.S.

Met. Observatory, Bolton, January 20, 1890.

Sheffield.

Meteorological Summary.

December, 1889.	Temperature. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for Dec.* Daily Max.	Means for Dec.* Daily Min.	Rainfall. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Dec.* Ins.
Sheffield	54°	17th	22°	29th	39°	—	—	1·54	16	0·40	21st	—
Spurn Head.	52°	18th	25°	27th	39°	—	—	0·96	17	0·32	8th	—
York	54°	18th	25°	12th	37°	43°	32°	1·26	15	0·57	6th	2·45
Barrow	50°	9th	29°	26th	40°	—	—	3·50	18	0·64	19th	—
Liverpool	54°	17th	27°	27th	40°	44°	36°	2·80	17	0·40	19th	2·70
Holyhead	53°	9th	31°	3rd	44°	47°	39°	4·07	21	0·86	19th	3·84
Oxford	54°	17th	19°	28th	37°	44°	34°	1·21	15	0·23	21st	2·13
London	55°	17th	23°	2nd	38°	45°	35°	1·50	18	0·25	22d	2·14

* The means of Temperature and Rainfall for December are for 15 years.

Pressure.

December 16, 1889, to January 15, 1890.

On December 16th pressure was above 30·0 in. in all parts of the kingdom, and as high as 30·4 in. in the S. It gave way in the N. on the 17th but remained high in the S., and on the 18th the isobars were close and pressure ranged from 29·5 in. in the N. to 30·3 in. in the S., remaining the same on the 19th, but falling decidedly on the 20th, when it was down to 29·3 in. in the N. and 29·7 in. in the S. There was very little change on the 21st and 22nd, but a gradual recovery took place on the 23rd, followed by a further fall on the 24th, and a decided rise on the 25th, when the barometer readings exceeded 30·0 in. in all places. The barometer kept high on the 26th, and on the 27th it was up to 30·5 in. in nearly all parts of England, and though it gave way on the 28th it was still as high as 30·2 in. It was high, steady, and even on the 29th and 30th, but fell low to 29·5 in. in the N. on the 31st, remaining above 30·0 in. in the midland and southern counties. On January 1st the barometer was rising steadily, the readings ranging from 30·0 in. in the N. to 30·4 in. in the S., but it fell slowly on the 2nd and 3rd, being low on the latter date. It continued low on the 4th and the changes were slight, but on the 5th there was a decided fall, and the isobars running from S.W. to N.E. were remarkably close, the barometer readings ranging from 28·8 in. in the N. to 29·8 in. in the S. On the 6th pressure recovered quickly, but a further fall took place in the N. on the 7th without affecting the S., and on the 8th pressure was lowest in the W. and high elsewhere. On the 9th it was again falling in the W. and rising in the N., being rather irregular, and on the 10th it was rising everywhere, but was not very high. On the 11th it was again falling in the N.W., but was above 30·0 in. in most parts of England, and on the 12th it was rising decidedly, the readings ranging from 29·8 in. in the N. to 30·2 in. in the S.W. On the 13th pressure was very irregular, and the same on the 14th, falling in the N., where it was down to 29·6, but rising in the S. and E., where readings reached 30·1 in. and 30·2 in. On the 15th there was a further fall in the W., but it did not greatly affect England, where readings generally were up to 30·0 in.

The Weather.

During the week from December 15th to the 21st the weather over the United Kingdom was for the most part mild and misty, rain falling on most days, though only in small or moderate quantities, and the wind at times reached the force of a gale. Between the 18th and 20th there was a temporary interruption to the mild weather, and frost occurred at some of the inland parts of England, but on the 20th temperature had again risen. Rain fell on seven days at Barrow and Holyhead, six at Liverpool and London, four at Sheffield and Oxford, and three at Spurn and York. From December 22nd to the 28th the weather during the earlier part of the week was mild, damp, wet, and misty, but towards the close the weather cleared up and the air became drier, while temperature fell decidedly, and on the 28th keen frosts were experienced, the thermometer readings falling as low as 20° at Oxford, 24° at London, and 27° at Liverpool. Rain fell on four days at Holyhead, and three at Sheffield, Spurn, York, Barrow, Liverpool, Oxford, and London. During the week ending January 4th the weather was very cold and unsettled, and severe frosts were experienced at most places with a good deal of fog, but at the close of the week temperature was rising. 13° of frost were registered at Oxford on December 29th, and 9° at Liverpool on January 1st. The rainfall was moderately heavy in the W. but light elsewhere. Rain fell on six days at Holyhead, four at Sheffield, Spurn, and Liverpool, and three at York, Oxford, and London. From January 5th to the 11th high winds were prevalent and the weather was wild and showery, with fine, dry intervals. No frost was experienced and the minimum daily temperature usually exceeded 40°, being unusually high for the time of year. Rain fell on seven days at Holyhead and Oxford, six at Sheffield and Liverpool, and three at Spurn, York, and London. During the week ending January 18th the weather still continued mild and unsettled, with strong winds and occasional heavy showers of rain. Thunderstorms occurred in the western parts of England. The day temperature usually exceeded 50°, and at night never fell down to freezing point. Rain fell on seven days at Holyhead, five at Sheffield, four at Liverpool, three at Spurn, London, and Oxford, and two at York.

Sun Spots.

On December 18th there was a group of three or four small spots, rather faint, north of the equator, and about one-third the diameter of disc from eastern limb. On December 21st there were six small spots spread over a considerable area to the north-west, and probably the same group, but changed, seen on the 18th. On December 25th there was a

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group of seven or eight spots, one moderately large and the others small, to the south of the equator, past centre of disc to the west. On December 30th this group was disappearing at the western limb, and there was a new round, well-defined spot near the eastern limb, which travelled along the disc and underwent little change till January 1st, after which no observations could be made till January 5th, and the sun was then spotless.

The planet Saturn comes into opposition with the sun on Feb. 19th, and will, therefore, be visible all night long. It is situated in the constellation of Leo, just below the two stars forming the handle of the Sickle.

E. HOWARTH, F.R.A.S.

Museum and Observatory, Sheffield, Jan. 20, 1890.

Reviews.

Journal of the Liverpool Astronomical Society. Edited by Herbert Sadler, F.R.A.S. Nov., 1889.

THIS number inaugurates a new volume of the useful publication of this society. It contains the address of the late president, the Rev. Father Perry, who advocates the further attention of members to solar physics, and especially a careful daily scrutiny of the surface of the sun. The report of the Council records the acquisition of a valuable telescope, the gift of T. E. Rylands, Esq., which it is proposed to erect in an observatory in a central position in the city of Liverpool, should funds be forthcoming for that purpose.

Assure. [Edited by A. Arthur Reade. Manchester: 1, Cooper Street.] —It is not everyone who has the gift of writing attractively on the subject of life assurance, a qualification which is possessed in a high degree by Mr. A. Arthur Reade, whose new monthly (now published at a penny) is making headway with its second volume. We pointed out, in a recent issue of *Research*, the need which exists for all who are engaged in the work of science teaching to give their earnest attention to the subject of insurance, and there is no better medium for their guidance than will be found in the pages of Mr. Reade's bright little journal.

Practical Observations on Agricultural Grasses and other Pasture Plants. By W. Wilson, Junr. 2nd Edition. [London: Simpkin, Marshall & Co. 1889]

THIS volume gives some information that will be of service to the farmer and agriculturist. As the author states in his preface to the second edition, a much greater interest is now being manifested by farmers in practical investigations as to the habits of agricultural animals, and in a scientific knowledge of the plants most likely to be useful. The work opens with an account of grasses and their place in the vegetable kingdom, followed by observations on the soil, climate, varieties of grasses, introduced plants, ensilage, and other topics. The question of the present condition of our pastures is discussed among others, and the author advocates that greater attention should be given to the study of botany in agricultural matters.

The Photographic Quarterly. January, 1890.—[London: Hazell, Watson & Viney. Price, 1s. 6d.]—The second number of this new high-class "quarterly" is fully equal to the promise of its first issue. It is embellished with a fine portrait in photogravure of Mr. Joseph W. Swan, F.R.S., and a delicately-toned "photographic study," entitled *Harmony*, by Mr. J. E. Austin. The literary portion is as excellent as the pictorial. Besides articles on the *technique* of photographic processes, Mr. W. J. Harrison, F.G.S., contributes a well-written historical article on the early pioneers of the art—"Wedgwood and Davy: What they did for Photography a Hundred Years Ago." Mr. A. Pringle dilates upon the "Present Status of Photo-micrography," and Mr. H. P. Robinson writes with his accustomed ability on "The Use of Nature and Idealism in Art." There are also several other articles equally well worthy of perusal. We must accord a word of praise for the excellent manner in which the "quarterly" is printed; we cannot, however, say so much for the binding.

Transactions of the Manchester Geological Society. Parts 11 to 13. Vol. xxii.

THE parts of this valuable publication now to hand contain many papers and reports of practical interest to the mining engineer and geologist. The use of roburite was very fully discussed at a special meeting held at Wigan. The address by the president, Mr. Henry Hall, H.M.I.M., was upon "The Duration of Our Coal Supply," and dealt with the subject in an exhaustive manner.

The Civil Service Guardian and County Council Courier.—This is a new monthly journal, the first part of which appeared on January 1st. It is described as a Monthly Review for Civil Servants, the County Councils, Town Councillors, and County Council and Municipal Officials. Judging from the number before us, which contains many articles of considerable interest, it appears likely to prove a valuable contribution to periodical literature.

Annual Report of the Liverpool Amateur Photographic Association. 1889.

THE twenty-sixth annual report of this prosperous association records, during the year, the largest accession to the roll of membership yet attained. An important feature of the year was the establishment of the permanent club rooms in Lord Street, Liverpool. An exhibition was held at the Walker Art Gallery, which resulted in a substantial surplus to the funds. The club rooms have been well furnished and the comfort of members well attended to. An enlarging camera has been provided among other conveniences. The meetings have maintained their interest throughout the year, and the lectures, lantern demonstrations, and "socials" or smoking concerts which have been given have been most successful. Excellent work, too, has been submitted by members in competition for photographic prints, enlargements, and lantern slides. Eleven excursions for outdoor photography were held, at which 913 exposures were made.

The Naturalist. January, 1890.—[Leeds: McCorquodale & Co., Ltd., Basinghall Street.]—The contents of this number are well calculated to be useful to the practical naturalist. Ornithology occupies a large share of attention, and some interesting notes of observations on birds are contributed from various districts in the north of England. Mr. T. Mellard Reade has a note on the causes of the coloration of red sandstones, and the Rev. C. H. Brinstead, M.A., describes some rare mosses from Cumberland. An account of the geological papers relating to the north of England, read at the British Association, appears from the pen of Mr. S. A. Adamson, F.G.S.; whilst the report of the Yorkshire Marine Zoology Committee is given by Mr. J. Percy A. Davis. A graphic narrative of a tour to the south of Spain, entitled, "Three Weeks on the Guadalquiver," by Mr. H. E. Dresser, is commenced in this number.

On a Fossil Fish (Chondrosteus) from Barrow-on Soar. By Montague Browne, F.Z.S. [Leicester: Geo. Gibbons & Co. 1889.]

This pamphlet is a reprint from the *Transactions* of the Leicester Literary and Philosophical Society, and records the important discovery of the rare Liassic fish *Chondrosteus acipenseroides* (allied to the sturgeons), from the neighbourhood of Barrow-on-Soar. Hitherto this form has only been known from the specimen obtained at Lyme Regis, described in the masterly monograph by the late Sir Philip Egerton. Mr. Browne, who has obtained the two new specimens for the Leicester Museum, gives an admirable account of the sturgeon family of fishes, and describes the peculiarities of the fossil forms. The skin of *Chondrosteus* was smooth, without scales, and its tint harmonised with the muddy bottom of the Liassic sea in which it lived, thus serving as a protection from the huge predatory saurians of the period. One of its features was a very powerful tail. Two folding plates, drawn by the author, show the bones of the head and part of the pectoral, dorsal, and other fins of the ancient fish, a restoration of which is also given in another illustration.

The Journal of Microscopy and Natural Science. January, 1890. *Edited by Alfred Allen and Wm. Spiers, M.A.* [Bath: 1, Cambridge Place.]

AN amalgamation having been effected between the journal of the Postal Microscopical Society and that of the Wesley Naturalists' Society, the editors now announce an enlargement of their magazine to 70 or 80 pages. The present part, which is the first of the new series, contains several excellent

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papers. Mr. Tuffen West, F.L.S., continues his interesting chats entitled "Half-an-hour at the Microscope." Mr. Swainson discourses on "Sea Urchins," and the Rev. W. N. Lett on "The Cells of Mosses." Mr. G. W. Leadcroft's presidential address to the Bath Microscopical Society is also printed in this number.

♦♦♦♦♦

The Physiography of the Lower Trias. By T. Mellard Reade, C.E., F.G.S.
[Extracted from the *Geological Magazine*, December, 1889.]

Few subjects in British geology have excited greater interest than the question of the origin of the Triassic rocks, the lower portions of which afford unmistakable evidence of being due to conditions differing from those under which the upper beds of the Trias were deposited. The frequent phenomena of current-bedding and the abundance of quartzite pebbles which are noticeable features of the Bunter sandstone have led certain observers, following lines laid down by Professor Bonney, to attribute the Bunter rocks to deposits by riverine action on a scale similar to that now taking place in Central Asia. Mr. Reade, in his paper read before the British Association, of which we gave a short abstract in a recent issue, and now printed in the *Geological Magazine*, objects to this view on the grounds that if the Bunter is a riverine deposit it would be found to follow well-marked topographical features, and it is impossible now to trace the course of any river valley, or even sandy plain, representing the deposits as they are conceived to have been laid down on this hypothesis. The characteristic features of the Bunter are constant over large areas, and it is pointed out that, whilst the actual source of the liver-coloured quartzite pebbles so common in the middle division of the Bunter is not agreed upon, it is practically certain that they are not the products of local rocks. Mr. Reade concludes that the Lower Trias were deposited by the sea in subsided valleys of Triassic age, and that the distribution and arrangement of the pebbles is all the work of tidal action. Though the theory is not worked out fully Mr. Reade's paper is a valuable contribution to the subject, and will, doubtless, receive the earnest attention of all geologists.

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Publications Received.

Wanted: An Institute, by Charles Madeley (Warrington Association for the Promotion of Technical Education); *Luminosity*, by Rev. H. H. Higgins, M.A. (Presidential Address to Liverpool Naturalists' Field Club); *Table and Formula Book*, by Rev. Isaac Warren, M.A. (Longmans, Green & Co.); *Third Annual Report of the Liverpool Marine Biological Committee.* The following publications for January:—*Naturalist, Life Lore, Assure, Knowledge, Brewers' Journal, Johns Hopkins University Circulars.*

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Obituary.

We regret to record the death on the 10th ult. of Mr. Edward Forbes Morton, the second son of Mr. G. H. Morton, F.G.S., at the early age of 33 years. He was for several years demonstrator to the late Professor Hamilton, at Queen's College, Liverpool, a member of the Liverpool Chemists' Association, and the Mineralogical Society of Great Britain. During recent years he filled an important position in the Queen Insurance Company which hindered his scientific work, but he was well known to many scientific friends in Liverpool and elsewhere.

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THE report and statement of accounts of the Newcastle Executive Committee of the British Association have now been circulated. The expenditure compares satisfactorily with the cost of entertaining the British Association in other towns, but a considerable saving might have been effected if the city of Newcastle had been provided with a suitable Town Hall. The accounts have resulted in a surplus of £76 11s. 5d. Of this, it is proposed to devote £51 to the cost of the permanent electric lighting of the Natural History Museum; the remainder to be expended in binding the minute books and papers relating to the meeting, any balance then remaining to be devoted to the Infirmary.

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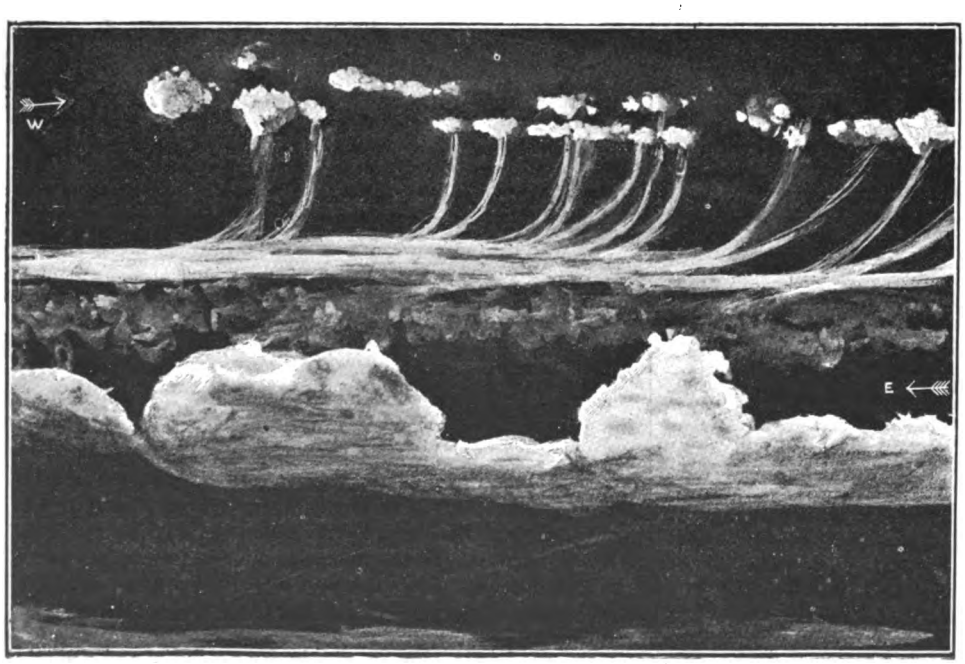
Letter to the Editor.

CLOUD-FORMS.

SIR,—I send a rough sketch of the clouds as I saw them in the North-east, on December 2nd, at 8 a.m., over the sea from Shanklin, Isle of Wight. The whole seemed illustrative of that mixture of west and east winds described in your December number as a frequent phenomenon accompanying haziness; there is a peculiarity in the tail-like wisps from the cirrhus clouds also, which was really as striking in some ways as the sketch so imperfectly makes it. The upper part of the easterly, and the lower portions of the westerly winds show condensation at their points of contact, and the cumulus seemed to be due to condensation of the vapours from the sea beneath by the colder east wind. The relative position and motion of these five cloud layers was made apparent.

Marine Villa, Shanklin, Isle of Wight, December, 1889. H. G. DIXON.



EXPLANATIONS,

A—Clear blue seen between gaps in lower strata.

B—Cirrhus—high up, going East; outlines pretty constant.

C—Remarkable tails, as if the under portion of B was being left behind.

D—Almost stationary; white layer streaked longitudinally.

E—Slaty coloured, misty films, going West, and changing outlines rapidly.

F—A clear space, much deeper than is apparent here (in Fig.).

G—Cumulus, going West. Upper outline continually rising and diffusing away. Lower edge (rising really) spreading out and growing continually, with outlines strengthening.

H—Misty, bluish "atmosphere."

Sea beneath.

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Research:

A MONTHLY ILLUSTRATED JOURNAL OF SCIENCE.

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NOTICES.

Several Reports of Societies have been received so late that we are obliged to defer their publication.

Bound Volumes, Price 5/-, or by post 5/6, can be obtained from Booksellers and News Agents, or from any of the Publishers.

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & Co. Price 3d., or by post, 4d. Annual Subscription 3s., or by post, 4s.

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Remittances and Communications respecting Advertisements, should be addressed to C. BIRCHALL, 32, Castle Street, Liverpool.

Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

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TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

"Physics of the Earth's Crust."*

THERE are not many works in existence devoted to mathematical treatment of geological problems, and Mr. Fisher's well-known *Physics of the Earth's Crust* is unique of the kind. Geologists have, in former years, excited the explosive wrath of the talented and witty Rev. Professor Haughton, of Trinity College, Dublin, who thinks that they seldom or never rise beyond problems of proportion, and that a sum in the simple rule of three exhausts their power of numerical investigation. There is a certain amount of truth in this, which arises from the fact that geology is based on observation of nature, and the pioneers of this interesting science have either been unfurnished with the requisite training, or they have considered the data to be of a nature unfitted for mathematical treatment.

There is, however, no doubt that the science has advanced to a stage in which accurate quantitative treatment is imperatively necessary. There are many and great physical problems awaiting solution, which can only be investigated by experimentalists and mathematicians combined.

A second edition of the *Physics of the Earth's Crust* has just appeared, the first edition having been published in 1881. The author wished to revise portions of the work in view of discoveries that have been made since that date, and feels, we sympathetically learn from the preface, that advancing years tell him that if he is to publish again, it must be done quickly. In addition to this revision of earlier work he has various ingenious suggestions to make for strengthening and supporting some of the conclusions arrived at.

Mr. Fisher tells us that he commenced his investigations under the belief that the wrinkles of the earth's surface were produced by the shrinking of the nucleus, through loss of heat, and the continuous readjustment of the crust to its diminishing body. This view he was compelled to give up many years ago, and in the first edition of his work, he attempts to show that the amount of compression which has taken place by secular cooling is insufficient to account for the protuberances of the earth's surface above a given base line. Since the discovery of the level-of-no-strain in a cooling solid globe, first announced by the writer, in 1886,† and by Mr. Davison three months afterwards, and more lately mathematically investigated by others, Mr. Fisher has had to revise this portion of his work, with the result of making the explanation of the corrugations of the earth's surface still more difficult on the hypothesis of secular contraction.

Chapter VIII. is devoted to this revised investigation, and will well repay perusal. The results are tabulated on page 106 with the result that on the most favourable hypothesis the depth of the level-of-no-strain is at the present time not more than two miles below the surface, leaving only that thickness of the crust for mountain and continent-making by compression. This Mr. Fisher computes would only produce 6⅓ feet "mean height of elevation," otherwise a spherical shell of that thickness of the diameter of the globe, an amount of material insignificant in comparison with the elevations that exist above

* *Physics of the Earth's Crust*, by the Rev. Osmond Fisher, M.A., F.G.S., 2nd Edition. Macmillan & Co., 1889.

† *Origin of Mountain Ranges.* Chap. XI.

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a base-level drawn at the deepest part of the ocean estimated by Mr. Fisher (page 112) at 13,224 feet.

The hypothesis that the oceanic depressions are the result of radial contraction is also investigated and dismissed as insufficient.

Contrary to the views now generally held by physicists that the earth is practically solid from the surface to the core, it is contended that the hypothesis of solidity fails, and that while there exist a solid shell and solid core, a fluid zone or shell-cushion, so to speak, occupies the space between them, commencing at a depth of about 25 miles below the surface. This view is also held by Le Conte, Prestwich, and several other geologists, and has been assumed rather for the supposed requirements of geological machinery than from any data more solid than itself. This shell-cushion being in Mr. Fisher's view a geological necessity he goes about proving its existence by a variety of very ingenious arguments drawn from observations with the pendulum in mountainous, non-mountainous, and oceanic areas, and from the thermometric gradients calculated from tunnel observations in mountains, and from borings in plains and inferences from the behaviour of volcanoes in various parts of the world. There is, however, a remaining difficulty not easily surmounted, viz., the absence of tides in this fluid shell affecting the crust above. It was formerly supposed that the limitation of the fluid part of the earth's interior to a thin zone got rid of these disturbing tides, but Mr. Fisher, who is above everything an honest and candid investigator, now admits that this hypothetical provision does not get over the difficulty. While considering that the presence of earth-tides is not proved he has thought it necessary to doubly fortify his theory by making the magma of the shell-cushion or fluid zone an elastic instead of a non-elastic fluid, and in this way seeks to destroy the tidal argument for the solidity of the globe. From a variety of reasons fully stated in the book it is considered highly probable that the fluid magma has a considerable percentage of water occluded in it in the form of water gas, and the evolution of steam which usually accompanies volcanic eruptions is pointed to in proof thereof. But still another assumption has to be made, namely, that the fluid underlying the crust possesses more specific gravity than the crust itself.

This is a necessity not seen, and, therefore, neglected by many less experienced theorisers than our author. If the fluid were of less specific gravity than the crust above, the crust would be in a state of instability, and would be continually breaking up and sinking therein. On the other hand, if the crust floats on a fluid heavier than itself, like ice on water, the fluid could never rise to the surface, much less be discharged through a pipe or throat rising several miles above the mean level of the earth, as is often the case in volcanic eruptions.

Now we see the use of the ingenious machinery of water gas. While under the pressure of 25 miles of crust this gas is dissolved in the fluid menstruum, but when by the opening of fissures in the crust into which the fluid rises, the gas expands, increases the volume of the fluid and decreases its specific gravity, it bubbles up from below and is discharged at the surface as vesicular lava. It may be described as a sort of extremely dense and viscid soda water. The author also tries to show—and this appears to us one of the weakest points of the book—that lava, granite, and iron expand in "freezing" or solidifying, independently of the presence of occluded gases. All practices in the arts prove the reverse.

Having now provided a crust about 25 miles thick, floating upon a heavier but energetic fluid, it remains to account for the depression of the ocean bed and the elevation of continental land. Obviously, if the crust were of the same thickness and specific gravity throughout, and the supporting fluid of equable specific gravity throughout, the surface of the earth would be a true spheroid, or to the observer on the surface a plane. As before stated, the height from the lowest ocean level to the mean height of the protuberances of the earth above it, as reckoned by Mr. Fisher, is 13,224 feet.

The inference is plain. We must either abandon our floating crust or it must be loaded unequally. From pendulum observations at various stations it is inferred that the crust is denser and thicker under the oceans than under the land, and, by another process of reasoning not easy to follow, the fluid underneath the ocean crust is made out to to be of less specific gravity than that under the continents. As with a thinner crust and greater elevation of surface there must be a considerable "head" of a denser fluid under the continents than under the oceans, it is not very easy to see why this difference of level and hydraulic head should not make itself felt in lifting up the bottom of the ocean, or, at least, largely destroy the efficiency of the sub-oceanic crust as a balancing load to the continental elevations. At all events the device appears to supply a state of unstable equilibrium.

The oceanic depressions and the continental elevations are now explained, but there exists another phenomenon not accounted for, and that is the horizontal compression which portions of the earth's surface have undergone, and the elevation of mountain chains. This, we think, is the *crux* of the whole thing, and should have been attacked first. Hitherto our author on this question has indulged only in destructive criticism, testing various hypotheses, and rejecting them one by one as insufficient.

It is not easy to state succintly the views held by him on this question, as they are mostly put forward in a hesitating and tentative way, but the suggested causes of lateral pressure appear to be these: the widening of fissures in the crust by the intrusion of the expansive and energetic liquid substratum and contained gases; the expansion of the molten injected matter on "freezing;" the reduction of the earth's diameter by the extrusion of the occluded gases, and, to a slight extent, secular cooling. All these causes are invoked, perhaps on the principle that "every little helps;" but the grand cause, far exceeding the whole of these, is found in the convection currents set up between the heavy fluid under the continents and the light fluid under the oceans. It is difficult to follow our author in his reasoning out of this theory, because of the function the dissolved water gas is supposed to play in these mechanical combinations.

Put into familiar "imagery," if so poetical a word be applicable, we may compare the machinery to that of a high pressure hot water heating apparatus, containing a certain proportion of liquified steam, the underlying heated mass of the globe being the boiler, situated under the sub-oceanic crust. Ascending heated currents rise from this origin, and flow on an ascending grade under the bottom of the crust until they reach the continents and are deflected downwards by the "roots" of the mountains, of which more anon. In this progress the fluid parts with some of its surplus energy in the form of water gas, through volcanic orifices and fissures in the crust. It thus becomes denser both by loss of heat and of expansive gases, and descends, travelling back into the aforesaid boiler to replace that on the ascending grade.

The movement of this substratum exerts a drag upon the floating crust, which it pushes landwards, and piles up the strata into mountain ranges. As, however, the crust under the oceans cannot be stretched it parts, in directions probably represented by the oceanic volcanic lines, and the molten fluid welling up from below seals up these fissures as they are formed.

Mr. Fisher considers that the horizontal compression of the crust produced by floating on and being carried forward by the heavier molten matter will thicken it downwards as well as upwards, and in this way he gets support or "roots" for his mountains which float like icebergs.

These are the bare outlines of Mr. Fisher's views, supported by an array of mathematics that will frighten most geologists. The ideas, however strange they may appear, even to those who have thought much on the subject, are worked out in great detail with considerable ingenuity. The ideas once adopted have been well thought out in their

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various bearings, and in this respect, differ widely from the crudities that often distinguish, or rather disfigure, similar cosmological speculations.

The duty of a reviewer is primarily, in our opinion, to give an account of the book reviewed, not to air the reviewer's own fads, or to show his immense superiority over the author of the book under notice. Still it may not be amiss to point out what appear to be weak places in this theory of the earth, as well as to exhibit the author's strong points.

It is impossible to read the book without admitting the author's open-minded fairness, sincerity, and absence of egotism. He deals with matters admitting of demonstration in a very able and conclusive manner, but this in many cases leads to destructive criticism, in which we venture to think he excels.

There is no doubt Mr. Fisher has done excellent service in helping to clear the ground of some time-honoured, perhaps, musty notions. When, however, he comes to the constructive portion of his work we venture to think he is too apt to run off into imaginative hypotheses, supported though they be by a great command of physical knowledge, and still more ingenious reasons and applications.

That any series of convection currents likely to arise in a molten fluid confined to a narrow zone or shell such as Mr. Fisher postulates should have sufficient energy to carry the crust of the earth, 25 miles thick, upon its back or bosom—which ever figure may be most appropriate—and crush the crust up into mountain ranges and down into the magma as mountain "roots" is hard to believe. No difference of specific gravity of the fluid obtainable on the assumption adopted would produce sufficient effective head to propel the crust horizontally with sufficient force to create the requisite lateral pressure for the production of a mountain range. While Mr. Fisher has devoted a large part of his book to destroying the grounds for believing that the corrugations of the crust are due to a shrinking of the nucleus, he on the other hand introduces an hypothesis founded upon a series of other hypotheses, which, if accepted, goes far to destroy the value of this reasoning.

What more effective way can there be of producing shrinkage of the nucleus than the provision of convection currents in the postulated fluid zone.

If the existence of such a zone traversed by such currents is admitted, the whole theory of the earth will have to be revised in a very thorough manner. The heat brought up from below and playing against the crust would also produce expansions unconsidered in the author's theory, and the shrinkage of the nucleus might be assumed to any amount.

On the whole we see no grounds for changing our views as to the solidity of the globe throughout, which hypothesis is consistent with a theory offering a more practical solution of the physical problems connected with the movements of the earth's crust.

T. Mellard Reade.

Vaucheria and a Parasitic Rotiferon.*

By Wm. Narramore, F.L.S.

A FEW months ago my friend, Mr. R. H. Day, of Bootle, supplied me with some filaments of what appeared to be an alga containing an animal parasite. The specimens were gathered from the Leeds and Liverpool Canal, near to Kirkby, at a point of the canal where an overflow was taking place; on the bank at this spot a large quantity of vegetable refuse had been deposited. The decomposition of this refuse supplied the water with a drainage rich in organic matter.

A cursory examination settled two points, that the alga was a species of Vaucheria, and the animal parasite a member of the Rotifera. A visit was made to the spot some two or three weeks later, when notes of the habitat were taken and further specimens gathered. I have made several prolonged observations of the plant and its parasite since, and many curious and important points have presented themselves for consideration and solution. I now purpose to give the account of these observations, and will first deal with the alga, next with the parasite, and thirdly with the relation of the parasite to the alga.

The question of the septation of Vaucheria will first be considered. Vaucheria belongs to the order of fresh-water algæ *Siphoneæ*, but by a more recent arrangement has been placed under a class Multinucleatæ. The alga is much and variously branched, but not usually septate, except during the reproductive stages, when the oogonia and antheridia are partitioned off from the tube before the process of fertilization takes place. Again: in the asexual mode of multiplication a septum is formed behind the cell contents at the end of a filament, which becomes marked off as a zoospore or swarm-cell.

In following the development of the zoospores I placed a number of Vaucheria filaments in a shallow vessel of water. Between one evening and the following a large number of dark green bodies appeared on the sides of the vessel and on the surface of the water; these are the zoospores (*figs.* 1 to 6).

The zoospore as it leaves the tube is a relatively large dark green mass covered with cilia. It is active for a longer or shorter time, usually only a few minutes, after which it settles down and begins to develop. The spore elongates with just a slight protuberance at one extremity; this is followed by another slight elongation, and next a constriction is noted. Following on a distinct tube is observed looking very beautiful with its newly-acquired loosely-arranged chlorophyll granules of pale green colour, in striking contrasts to the denser and darker colour of the globular or oval zoospore (*figs.* 7 to 10). One or more tubes sometimes arise from different points of the zoospore, a filament from opposite sides, or one with a single projection which immediately subdivides and two diverging tubes are formed. Filaments produced in this way may grow to a considerable length; twelve inches given by some writers, but in *Vaucheria sessilis*, *V. geminata*, *V. terrestris* and other species which I have examined, no such limit can with certainty be given. Under favourable conditions of substratum and moisture a much greater length is attained. I have grown *Vaucheria sessilis* in a tall glass of eight or nine inches high, and the plant has again and again reached beyond the level of the water, growing over the mouth of the cylinder, and in ditches I have found it nearly two feet in length. Think, then, of a filamentous alga, a tube of relatively large diameter, running for this length without a septum; presenting in reality a unicellular structure of enormous length—not alone the parent filament, but often the many branches forming but a single cell. The time comes, however, when the alga must multiply, and now at one extremity for the first time a septum is formed, and a portion of the cell contents is shut off from the rest of the filament and forms a zoospore, which becomes covered with cilia and leaves the filament to move for a brief time in the water before settling down to develop. Should the tube develop structures destined to become true productive organs, oogonia and antheridia, these are in nearly all cases shut off from the main tube by a septum.

Now I think it will readily be seen that, for purely vegetative purposes, the alga remains undivided; but in both asexual and sexual modes of reproduction the necessity arises for septation, morphological differentiation with division of labour. All parts of the plant do not perform functions indifferently, one part for vegetation and another for reproduction.

How is it that this essentially unicellular Vaucheria becomes septated in more than the two parts already referred to? For in the specimens under investigation, not one or two but many of the filaments were septated. I was much impressed with this appearance, although it was not the first time I had met with something similar. I remember some three years ago gathering some *Vaucheria sessilis* from a pit in the brick field near Sheil Road, Fairfield, and finding many of the filaments

* Read before the Liverpool Microscopical Society, December, 1889.

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constricted into what appeared very like a string of miniature green sausages. In this case the filaments had been as it were twisted, so that the whole of the cell-wall was involved. In the present case (*fig.* 11) the cell-wall takes no part in the formation of the septum; it undoubtedly begins from within, and from the protoplasm immediately within the cell wall, the primodial utricle. No one filament was divided uniformly throughout, but several had many septa, dividing the cell contents into portions or segments of varying length, four to seven times the diameter of the tube. The alga at first sight presented the appearance of one of the CONFERVACEÆ, *Cladophora crispata*, but beyond the elongated cell arrangement it really had nothing in common.

Now the occasional septation of Vaucheria has been regarded as a result of injury to the filament. This view was, I believe, first taken by Stahl, from observations on *V. geminata* in 1879, and has since been repeated by Bennett and Murray, and by Goebel. Dr. M. C. Cooke refers to a gathering of *V. sessilis* made by Mr. F. Bates, of Leicester, and says—"The unusual septation, as it appears to be, was general throughout the gathering," &c. The views expressed by these writers that septation is brought about either as a result of injury to the filament, or it is connected with reproduction; either in the production of zoogonidia or resting cells, each developing into Vaucheria tubes; or a number of masses of protoplasm are set free with amœboid movements, and these directly or indirectly develop into Vaucheria tubes.

The Vaucheria examined I consider *V. dichotoma*. The septa in most cases appear to be ingrowths of the principle utricle, and not of a gelatinous nature. The uniform character of the septa, to my mind, excludes the idea of "result of injury." Further: in some filaments the almost uniform length of the segments marked off must presuppose uniform injury to the filament at the several points, which is most unlikely. *Fig.* 12 shows a filament with an unusual arrangement of branching, but the septa, both in the main tube and its branches, are well formed and of a normal character. Whilst there is no doubt that in some cases the septa are formed directly by the ingrowth of the protoplasmic layer next to the cell-wall, *fig.* 14 exhibits a peculiarity worthy of consideration as bearing on the formation of these septa and segments. Here the contents of the tube appear to have been destroyed up to a definite point, and probably by the presence of the parasite Rotiferon, which will be considered later on. In passing I need only remark that a certain length of the tube at one extremity, including the so-called "gall," has been completely emptied of its contents, the Rotiferon and its family having escaped at the apex of the "gall," where an opening is observed. The contents of the tube thus being destroyed or consumed by the parasite, the uninjured portion of the contents commence to grow and elongate into the vacant portion of the filament. The evidence of this is clear enough from the tapering extremity of the new structure, the new cell-wall completely investing it, and perfectly distinct from the cell-wall of the old tube. The new growth has its rounded extremity covered with a portion of the cell-wall. Now con ider that as this point increases in diameter it will come to occupy a space completely filling the old tube similar to its opposite extremity. The septum formed will be to all appearance like the normal structure found in segmented or multicellular filamentous algæ. Some of these septa no doubt have resulted from the action of the parasite within. Others have such a striking uniformity that they appear to be *regular* deviations from the normal conditions of the thallus, the septation occurring frequently and under varying conditions of environment, and found in widely-separated localities.

The alga was formerly described under the name of *Gongrosira*, and I think that careful and extensive examination of the alga may lead to a separation of the structure from the *Vaucheria* genus. As bearing on this point and the next, the following is quoted by Bennett and Murray, *Handbook of Cryptogamic Botany*, p. 213.

"The normally unicellular thallus is liable to *segmentation* as the *result* of *injury*; and even when uninjured has a tendency to become septated by thick gelatinous walls. In this condition it was formerly described as a distinct organism under the name *Gongrosira*. These Gongrosira cells when isolated develop into ordinary plants, or sometimes their protoplasm breaks up into fragments, which escape from the cell-wall and move about with an amœboid motion. They invest themselves after a time with a cell-wall, and remain in this condition, no spherical resting-cells or hypnospores, finally developing into ordinary filaments."

The liability of Vaucheria to frequent change of conditions of habitat, now submerged, now alternate wet and drought, or a period of weeks depending upon the moisture of the soil alone, seem to me to largely determine the necessity for septation. The cytioplasm of the tubes becomes condensed in short lengths, and these portions are more likely to subsist under the above conditions than the whole filament when so exposed.

The next consideration is whether the septation of Vaucheria is connected with reproduction. Do the contents of the tube segment and then each mass of cytioplasm segregate into smaller protoplasmic masses, and move about in an amœboid fashion? This view is taken by Stahl, and quoted by Goebel, and by Bennett and Murray. My observations are as follows:—In some cases, in advanced tubes, and in others in young tubes, I have noticed the formation of minute disc-shaped bodies; these are seen in different parts of the tube. Now in segmented parts, again in tubes perfectly unsegmented. In the case of a tube fractured these disc-shaped bodies move out; the movement may not be an independent one, but rather depending upon the contraction of a portion of the contents of the tube. But watching these bodies, when out of the tube, they seem to have a rotary movement, seen as several of them passed along the length of an adjacent filament. In a very close examination, under 600 dia. mag., in one instance only did there appear to be a trace of cilia. It must at this point be stated that these disc-shaped bodies are surrounded by an exceedingly-delicate film of protoplasmic matter, each containing a number of granules of chlorophyll, many undergoing bipartition, and arranged in circles (*fig.* 16). The discs at times found three or more in a larger envelope of protoplasmic matter, and each smaller disc within similarly invested with a delicate pellicle. Whilst the presence of cilia is somewhat doubtful, the yielding and extensible nature of the investment was evident and placed beyond doubt. These bodies are not limited to the septated tubes, but, as I have already stated, they are found in unsegmented tubes and of varying ages. They cannot, therefore, be regarded as the products of the cytioplasm of the segmented tubes alone; nor can the septation of a tube be looked upon as a preliminary step in the segregation of the contents for the production of "zoogonidia" or "swarm spores," as similar bodies to these appear to have been called by Stahl and Cooke.

Fig. 12. I have observed these disc-shaped bodies moving freely in the tube. At first they appear to be passively carried along, but this presupposes the existence of a movement of the cell sap sufficient to produce the motion of the bodies at a rate relatively quick. This is scarcely likely to be the case, as no other bodies are to be seen in motion; the movement of the disc-shaped bodies must be dependent upon intrinsic structure, and, doubtless, the contraction of the protoplasmic investment is the real cause. This may possibly represent the amœboid movement referred to by Stahl. As to the destiny of these bodies and how they escape from the filament, I have noted no means of exit, except under the accidental conditions of the fractured cell-wall. And as they are not alone found in advanced filaments, in which condition provision may be said to be made for the escape of these moving bodies, it appears to me to be extremely doubtful if either the segmented condition or the old condition of the tube can be assumed to be directly connected or concerned in the reproductive process as far as these so-called zoogonidia or swarm cells are concerned. If these conditions are necessary, why, then, are these bodies found in the unsegmented tube, and also in the youngest branches and filaments? The fracturing of either would set free bodies precisely similar to those set free from the old or segmented tubes. I regard these bodies merely as portions of the protoplasm containing chlorophyll granules which

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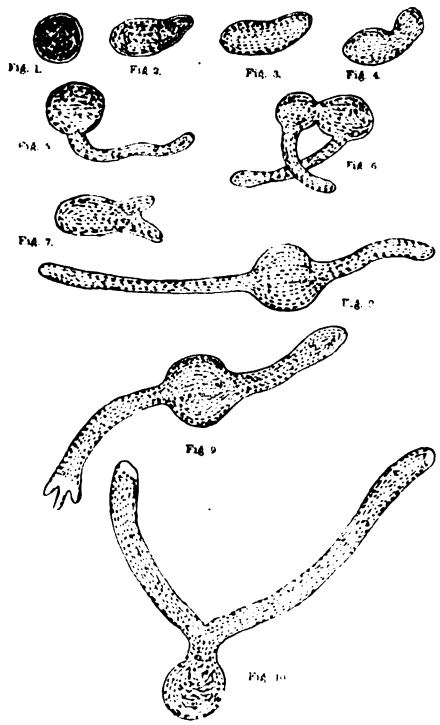

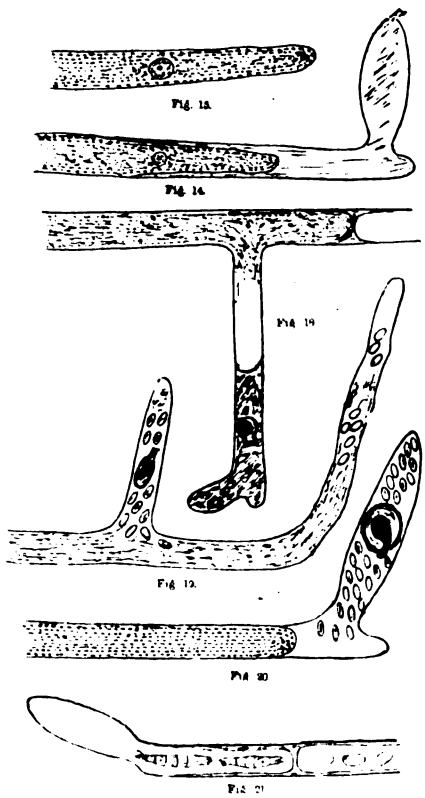

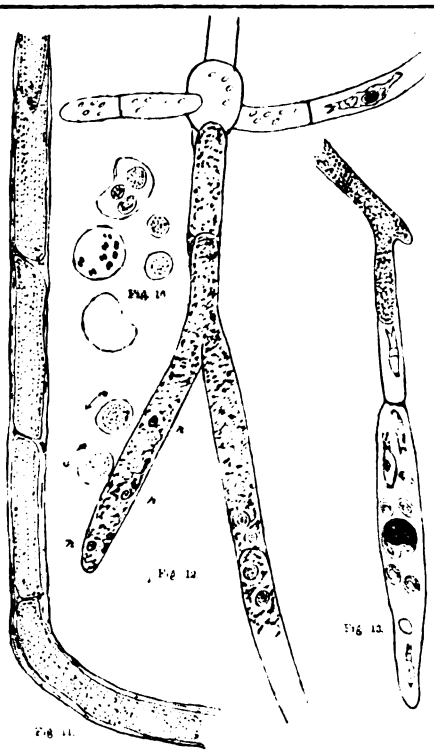

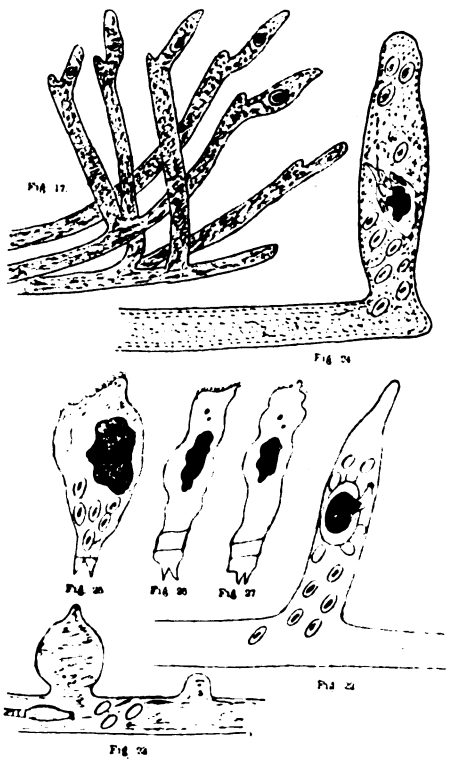

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naturally separate, owing to the comparatively loose nature of the cytioplasm of the Vaucheria tube. The movement of these bodies in the tube may be caused by the contraction of the protoplasmic investments of the bodies, or owing to the escape of the cell contents at some other part of the tube.

Nucleus or Nuclei.—The disc-shaped bodies already referred to have in many cases the appearance of nuclei, but the chlorophyll granules present, and which are always very distinct, readily distinguish these bodies from the real nuclei. The multinucleate character of Vaucheria does not appear to have been directly observed by many investigators in this country. In Bennett and Murray's *Handbook of Cryptogamic Botany*, p. 281, we read—"The very large number of Nuclei is universal in the Siphonocladaceæ; and although their occurence in the Siphoneæ rests chiefly on the evidence of Schmitz, there can be little doubt that this order also shares in the peculiarity, which does not lead on to *cell division*, as in the groups of algæ already described, and this must clearly be regarded as indicative of a lower or more ancestral type of structure."

In *fig.* 12 a young branch of *Vaucheria dichotama* shows three nuclear-like bodies, and in *figs.* 14 and 15 a single nucleus is observed; when viewed under a mag. of 400 dia. it presented a distinctly granular character with a denser nucleolar structure nearly central, and this body much larger than any of the granules around. A further examination of the nuclear body by aid of reagents, methyl green and acetic acid, the foregoing observations were confirmed, and hardly a doubt now remains in my mind as to the true nuclear nature of these bodies.

The presence of the parasitic Rotiferon in Vaucheria appears to have been first observed more than sixty years ago, later by Magnus and Balbiani in 1876 and 1879. About 1882 Mr. F. Bates, of Leicester, made some communications to Hudson and Gosse, and a notice of same appears in their monograph on the Rotifera. Mr Bates also communicated with Dr. M. C. Cooke, M.A., on the septation of Vaucheria.

I have recently had a letter from Mr. Bates, in which he says:—

"I used to find the Rotifer in the Vaucheria very commonly, both in plants growing in the water and in damp soil; it produces variously-formed and curious growths out of the Vaucheria thread. As to the curious rounded spinose bodies that I found in *Vaucheria sessilis* and *Vaucheria geminata* I never made out what they were, although I daily observed the threads containing them till they became rotten without finding any perceptible change in these bodies. I used to find them in the tubes and also in the antheridia and oogonia; in these cases there was never a septum formed cutting these sexual cells off from the main tube."

Professor S. Balbiani made some observations on a Rotiferon inhabiting "galls" of Vaucheria, and the Rotiferon is described as *Notommata Werneckii*.

I will, before referring further to these observations, proceed to give an account of the parasite as observed in the gatherings of Vaucheria under consideration (*fig.* 17). The first specimens examined presented a number of filaments of *V. dichotoma*, growing nearly upright, and most of these terminating in dilated club-shaped ends at a slight angle, the main filament or branch, as the case may be, suddenly terminates, forming a kind of "cul-de-sac," close to which the lateral club-shaped growth, the so-called "gall," projects. Inhabiting each is a parasite, noted particularly by its dark central mass, the stomach, and the light peripheral part. Whilst there is a striking similarity in these outgrowths, there are minor differences in form. The dilated character certainly lends countenance to the view that these structures may represent modified oogonia.

In some cases the outgrowth takes place almost at right angles from the side of the filament, and represents a structure more like the normal vegetative branch, or, regarding it as an abbreviated branch, it will then look like an antheridium.

The parasite, however, is not confined to these outgrowths, but often found in the main filament. As far as the fully-formed reproductive structures are concerned, I have not had opportunity of observing many of these. *Fig.* 23 gives a view of a portion of a filament with the oogonian mature and the antheridium just beginning to develop. The cytioplasm of the tube had all disappeared, and only a little dirty brownish matter remained behind. At the base of the oogonian, however, there was seen a Rotiferon and three oval bodies, the eggs.

The Rotiferon in the filament is difficult to make out and to figure in detail; the contraction of the body, the constantly changing outline, and the movements from side to side and up and down, and further in the perfectly healthy tube it is partially obscured by the cell contents. To dissect out the animal from the filament without injury proved a matter of no small difficulty.

Fig. 24 is a view in outline mainly of the female Rotiferon in the so-called gall with a number of eggs, some within the body cavity of the animal, and others deposited at different parts of the tube. One egg close to the tail was seen to keep this position notwithstanding the activity of the animal; it appeared quite ready to be deposited, but after two hours' close observation patience was left unrewarded. The exterior of the Rotiferon (*fig.* 25) is perfectly soft, and the anterior end is sloped off on the ventral side on which a line of cilia is arranged, these features making it look more like a member of the genus *Proales* than *Notommata*. The foot is very short, and there are two toes; stomach very conspicuous as a large irregular-shaped dark brown mass, surrounded by a lighter coloured ring; the eggs, those found in the gall as well as those found in the cavity, are oval; slightly granular contents and yellowish, the hyaline shell thin; probably they represent what is known as summer eggs. The other internal organs had apparently been reduced; no glandular structures, no nervous, no vascular system traceable. This may be a common condition of the parasite, for the many examined during the past three months from the end of August to the end of November, when my specimens ran short, were nearly all in a degenerate condition, that is, with a reduced internal anatomy. Some, however, had a decidedly different outline, and without eggs, but the condition of these was younger.

Fig. 12, *in situ*. *Figs.* 26 and 27, enlarged views. The anterior ciliated arrangement differs in being less prone, and this corresponds more to the *N. Werneckii* type; the posterior is segmented by two rings; the red pigment spot is represented double, but this condition is likely only apparent; it appeared *to be* by the animal moving, and bringing into view the opposite sides of the pigment spot situated on the cerebral ganglion.

Referring to the young condition of the Rotiferon it is decidedly vermiform, seen as soon as the animal leaves the egg; the segments are visible running throughout the length of the body, but as development proceeds the rings of the skin appear less pronounced and fewer in number, until finally they disappear, except perhaps one or two at the tail end (*figs.* 13, 21, 23).

In one young form the head was observed to be curved forward and a beak-like projection from the ventral side; doubtless this latter represents the part named the upper lip by some observers; the pigment spot was beyond the position usually occupied by the eye-spot in the *Notommata*. The movements of the young within the egg, the hatching of several was observed (*fig.* 13). Mr. R. H. Day sent me a graphic account of four hours' observation on the hatching of the young Rotiferons. He says:—"I saw the hyaline shells break, and out came the young vermiform Rotifers; in their struggle to escape they helped to break other eggs . . . . these Rotifers always make for the end of the tube (better food I suppose); they grow and deposit their eggs; one laid forty-seven, with more to follow had I waited . . . . How do they get into the tubes? Many filaments only contain a Rotifer and no eggs, and that a small one."

The Rotiferon now described will, on the whole, agree with what has hitherto been named *Notommata Werneckii*. Two or three features

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require further investigation before a definite opinion, however, can be pronounced on this point.

The relation of the parasite to the alga must form the third part of this paper.

That it is a true parasite there is no doubt; the Vaucheria affords board and lodgings for the Rotiferon. We have already seen that the animal is found throughout the several stages of development in different parts of the tube—from the young form just hatched to the adult female depositing her eggs for the next generation The animal must, therefore, feed on the contents of the tube. It is asserted by Professor Balbiani (*Journal Royal Microscopical Society*, Aug., 1879) that it is "nourished exclusively on the colourless plasma of the capsule, as is seen by the entire absence of green colour in the digestive tube." "This confirms the observations of M. Chantard and M. Felix Plateau, that chlorophyll is not an assimilable substance." My observations lead me to question these points. The parasite moves up and down the tube or the gall by a series of vigorous efforts; the younger forms move with more ease, but the cell sap and the strands of protoplasm present, together with the protoplasmic discs with their chlorophyll granules, form the difficult medium through which the parasite must press, and which must also form the pabulum upon which it feeds. This would appear so from the conditions of its surroundings. Next, it is frequently the case that a first portion and then the whole of the peripheral layer of chlorophyll, which is really the inner layer of the primordial utricle, becomes used up, and the parasite still found in the empty or almost empty tube. Another consideration is the very conspicuous condition of the stomach of the imprisoned Rotiferon. As we have shown above, the stomach presents a large irregular mass of brownish and black colour, and this colour arises directly from the contents of the organ. Is it likely to arise from the exclusive feeding on the colourless plasma? That non-parasitic Rotifers do feed on chlorophyll bodies is a matter of common observation. That the chlorophyll matters become changed in character and colour from the action of the juices of the glandular structures, passed into the alimentary canal, is also a question of little doubt. That *Notommata Werneckii* at one period of life at least, is well fitted with glandular structures, opening into the alimentary canal, is shown by Professor Balbiani himself. I have observed so many filaments with septa, and the parasites found in the compartments formed by the septa, with the chlorophyll nearly if not entirely gone, that I have no doubt that the parasites consume the coloured matters.

The parasite moves along in the filament mainly by the contraction of its body structures; the cilia around the oral aperture do not play the part of a wheel to draw in the food particles, but by close application to the food the animal grubs in the particles, so that there is not the same opportunity of seeing the green bodies pass down the alimentary canal. The presence of the Rotiferon in the filament and the consumption of the cytioplasm of the filament by the animal is, to my mind, the cause of its destruction.

The formation of the so called galls. On this point Professor Balbiani positively asserts that the galls of Vaucheria are altered reproductive organs, the oogonia, and is a case of hypertrophy of the structure after the reproductive functions have been completed. The figures accompanying his paper certainly seem to show the correctness of the inference; but it must be remembered that the observations referred to *Vaucheria terrestris*, in which the antheridium and oogonium are borne close together on the subdivision of a branch. In *V. dichotoma* the antheridium is distinct and separated from the oogonium (*fig.* 23). The septation of *V. terrestris* takes place some distance up the branch bearing the oogonium; in *V. dichotoma* it is cut off from the tube at the base, and the oogonium is sessile. It is evident that a similar structure called an "excrescence" by Balbiani could not be formed in *V. dichotoma* or *V. sessilis*. The difference between these species according to Hassal is very slight; in the same manner accordingly the gall is not a hypertrophied oogonium.

That the galls are lateral developments I have no doubt; that they may be stimulated to grow into the particular club-shaped structures by the action of a secretion of the parasite is very probable. That the club-shaped structures in *V. dichotoma* are freely found towards the extremities of filaments is perhaps significant; but again the structure is sometimes found midway of a long filament, formed at right angles to it; this latter may be a hypertrophied antheridium, but in no case have I found any trace of the reproductive structure in this development. In a matured oogonium I have not noticed the presence of the parasite, but very near the oogonium, as seen in *fig.* 23, but I should not be surprised to find it in the reproductive structures.

Closely connected with this preceding question, is the one the entrance of the parasite into and exit from the filament.

In *V. dichotoma* I have never seen an opening either in the true reproductive structures or in the galls, until such times as they have been emptied of their contents and the wall of the filament begins to decompose. Apertures may then be noticed, but certainly nothing of the nature of a specially-contrived mode of egress and ingress, as described and figured by Professor Balbiani. On the contrary, the openings I have noticed in *V. dichotoma* have resulted simply by the rupture of the cell wall at the apex of a gall when the structure has been in a condition verging on disintegration and completely emptied of its contents. It may be suggested that other organisms, *e.g.*, Infusoria have entered the gall and worked the destruction. This objection has already been anticipated above; for both parasites and eggs have been observed in tubes almost cleared of their contents, but having no visible opening.

"The young *Notommata* is said to leave the tubes of *V. terrestris* by the opening at the apex or at the base of the galls, then to swim freely in the water, take no food for this period of free life, and soon to return to the plant never again to quit it. The re-entrance is effected through the various openings of the capsules, and into the green branches."

I must wait further opportunity for observations on this point. At present as far as *V. dichotoma* is concerned the parasite leaves the gall or the filament, as the case may be, at the time the structure decomposes. How it enters, except it be by the same channel, I cannot offer a decided opinion. I have carefully watched the development of the zoospores, but so far have found no trace of the parasite at the early stages of growth of the alga. The eggs are too large to be directly introduced, and the young Rotiferon itself is large enough when it leaves the egg to require an aperture of sufficient size to be easily seen under moderate magnifying power.

The Evolution of Man.

THE Royal Society of Edinburgh held a special meeting on the 27th January to hear Professor Calderwood on the evolution of man. There was a large attendance of Fellows and visitors representing both sides of the question. Dr. Calderwood pointed out that the common condition of organic existence, from the lowest form to the highest, was the sensory-m tor nerve system; and that the main question was what was this system equal to—how much could be scientifically made out as lying within the range of such a system, highly differentiated and co-ordinated in an elaborate nerve centre? The system provided for activity of life by placing organism in vital relation with its environment. But how could sensory-motor action evolve a rational activity, as in man? Accepting all the conditions as laid down by the evolutionist, there still remained a set of difficulties of a seriously perplexing order. How did thought originate? The apparatus of sensory-motor nerves could not do more than supply impressions; they could not produce thought. Thought was itself a necessity of pre-supposition in order that any such experience as man's might be possible. Sensations were continually arriving and continually passing away; but the very idea of this change implied thought. The

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movement of the foot and the utterance of a word were actions widely apart. Whenever thought weds itself to speech, that is a creation. The intervention of thought was an occurrence different from all that could be traced in the lower orders of life. In lower intelligences the law of pleasure and pain ruled their lives. But when thought was in the ascendant the power of restraint was observable. How could evolution account for a life which was capable of rational self-direction? How could intelligence be evolved out of mere organism—an intelligence which first directed its own activity, and then directed organic activity? And beyond the rational intelligence, how can moral power be evolved from any amount of mere organisms? The higher government of moral life has other origin. Dr. Calderwood's position may be thus summed up:—So far as human organism was concerned there seemed no overwhelming obstacles to be encountered by the evolution theory, but it seemed impossible under such a theory to account for the appearance of the thinking, self-regulating life which was distinctly human.

Professor Rutherford replied most powerfully from the physiologist's point of view. He was of opinion that consciousness came out of molecular activity. Unconsciousness could be produced in the lower animals as well as in man by the molecular action of chloroform. Accordingly there must be consciousness in the lower animals; and if there were consciousness there were different sensations and different ideas derived from these, and gradually there was evolved the direct action of the ideational centres. The molecular mechanism in the brain gradually, in the course of ages, acquired power, and had led up to that condition which was called human thought. Could that power be lost? Could the opposite of evolution take place? Let them go to any lunatic asylum, and they would find that it could. Thought would be unable to control passion there; the individual was reduced to a sensory-motor mechanism. He considered that there was no other theory intelligible than that a change had taken place in the human brain. Then if the reasoning power was *lost* by a change in the human brain, why might it not be *acquired* by a change taking place in the human brain? The one cannot be maintained without the other. Accordingly mind was only the summation of brain functions.

Dr. Teape pointed out that, among the lower animals, life was entirely a creation of law; whereas the life of man was not a creation of law, but the direct outflow of the higher life. In reply to this Professor Ewart showed the gradual development of the individual. For a time the child was capable only of receiving simple impressions without being capable of thinking about them; and, so far, it did not go beyond the lower animals. Afterwards it began to *think about its impressions*, and therein lay the difference between man and brutes. It was extremely difficult to explain how the power of thinking about ideas had originated in man; but the fact of the gradual development in the individual history of every man seemed to imply that there was no direct break—that there was no time when intelligence was produced or showered into the individual. Another point of extreme interest was the question of language. Until language had been acquired, the power of thinking about one's thoughts was practically impossible. Here, again, they had a gradual development. The evolution of language was quite as striking a thing as the evolution of the organs of which animals were composed. That seemed rather in favour of the idea of continuity.

Professor Butcher replied to Professor Rutherford's two arguments. The first of these was that thought was accompanied by molecular activity. But, granting that molecular activity accompanied thought, it was surely no valid reason to say that it was the *cause* of thought. Again: it was said that because consciousness could be arrested by molecular activity, therefore consciousness was caused by molecular activity. Now, though the blow from a stone could arrest life, was it reasonable to assume that the blow from a stone would produce life? Thought, too, was found distinct from sensation among some of the lower animals—notably the dog. This animal showed the use of memory, and memory implied thought. Accordingly the difficulty of making the transition from sensation to thought was almost as great when they were dealing with the higher forms of brute intelligence as when they were dealing with man himself. Professor Duns characterised as unwarrantable the assumption of many evolutionists that animals as we at present had them were ever changing. For Agassiz, the celebrated naturalist, in the last paper which he wrote, said we had no such evidence before us at the present moment. The sculptured ibis of the Egyptian temple is not distinct in species from that of the present day. Evolutionists were too sanguine in making great generalisations from very imperfect observations.

Dr. Clouston, the eminent medical attendant of the insane, supported Professor Rutherford's views. According to his extensive experience, when a human being of high intelligence passed into a condition of reversion he lost his moral qualities, then his intellectual power; then his speech became disintegrated, then his power of locomotion became impaired, until he reverted to lower animal mental conditions, sometimes manifesting the appetite for ill-smelling garbage. Such a series of facts as these made surely in a general way for the evolutionary theory, especially when the question was asked—Was there any break, was there any one human faculty the rudiments of which could not be traced in one of the lower animals in some shape or form?

Professor Flint, the chairman, twitted the speakers by saying that with such a variety of views they could scarcely all have been "exact science." But there was hardly any subject which could be more useful or appropriate for the expression of divergent views and the criticism of one author's opinions than this great subject of evolution. Evolutionism was for the thinking men of the present generation what Aristotelianism was for thinkers in the middle ages, and Cartesianism was in the seventeenth century—one of the great theories necessary for intellectual progress. While the power of those theories was very largely justified by the truth that was in them and the good they did, still their domination tended to over-deductiveness, to a certain tendency to take seeming explanations too easily, and to devise hypotheses, which were readily accepted, but which experience did not confirm. Enthusiasm was good, but caution was also good.

Thus ended the most interesting discussion in the Royal Society for many a year—where it began.

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Scientific Research in Yorkshire.

THE Yorkshire Naturalists' Union three years ago increased its already wide sphere of usefulness by appointing a committee for special scientific research. There were several important branches of various sciences which could not possibly be investigated on the ordinary field excursions of the Union so as to ensure successful work, and continuous investigation had to be conducted during the whole year. The Union has affiliated with it forty local scientific societies spread over all parts of our broad county, and, with its membership of 408 and associateship of 2,519, it must be admitted that it is an organisation eminently fitted to carry on observations and investigations upon special matters connected with those sciences coming under the scope of the Union throughout Yorkshire. The first committee, appointed as alluded to, is for the purpose of receiving reports and conducting observations relative to the Erratic Blocks of Yorkshire, including particulars as to their position, height above the sea, lithological character, size, and origin, and to work upon the same lines generally as the Boulder Committee of the British Association, to whom annual reports have been and will be presented. It is known as the Yorkshire Boulder Committee. Since then, encouraged by the striking success and valuable results achieved

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by this committee, several additional ones have been commenced by the Yorkshire Naturalists' Union to work in conjunction with similar committees of research of the British Association. Three of these new committees are connected with geology, and the geologists of Yorkshire must be gratified at the progress their favourite science is making all over the country. Thus, in addition to the question of glacial geology, the fossil flora of Yorkshire, its coast erosion, and now the photography of typical or temporary sections are receiving special attention. Reports of these committees will be presented at the meeting of the British Association at Leeds in September, 1890, and every Yorkshire geologist must feel it an imperative duty to give the utmost assistance, so that the results then presented may redound to the credit of our county, and to Yorkshire scientists in particular. The visits of the British Association invariably result in valuable and important papers or reports being given bearing upon the locality visited, and we must see that Yorkshire is well to the fore in this respect. We have opportunities in all parts of our splendid county for practical research such as the majority of English shires do not possess, and the coming visit of the British Association must be made a memorable one by the new facts presented and the new investigations detailed and reported. A few words upon each of these special committees in connection with geology may be said with advantage.

The Yorkshire Boulder Committee.

The objects of this committee have already been stated, but its history and success may be briefly alluded to. The Boulder Committee of the British Association has been in existence since 1873, but up to 1886 only seven reports had been received from Yorkshire in an intermittent and haphazard manner. It was felt that before the British Association Committee closed its labours, which might be at any time, some determined effort should be made by Yorkshire geologists to remove this stigma. At the end of 1886 our County Committee was established, and at once commenced operations. Continuous and active work has since been carried on, with the result that at the Manchester meeting of the British Association 15 reports were presented and accepted; at the Bath meeting the number was 63, and at the Newcastle meeting 58, making a total of 136 reports already presented by this committee to the British Association. There have also been received a gratifying number in readiness for the Leeds meeting, but it is earnestly hoped these will be largely added to. In addition a Boulder Map of Yorkshire has been prepared, showing the position and character of the blocks reported. When these are transferred to a contour map, as Dr. Crosskey suggests, the dispersion of erratic blocks over Yorkshire can be readily understood. Special schedules have been prepared and will be gladly forwarded upon application to the Secretary, upon which may be recorded observations on isolated erratic blocks or boulders, or groups of boulders; that is, in other words, masses of rock evidently transported by natural agency from some locality more or less remote. Geologists have for some time recognised the great importance of this special subject, as its careful study will explain many of the phenomena of the glacial epoch, and will clear away many of the speculative theories involved in glacial geology. In the British Association report, presented at the Newcastle meeting, the committee say "it would be of great service if a committee like the Yorkshire Boulder Committee were formed in every county; were that done the record of English erratics could soon be made complete, to the great advantage of the students of glacial geology. The Yorkshire committee carefully examines the reports presented to it by individual observers, and collects typical rocks to aid them in the determination of the specimens sent." Such an eulogium from the greatest glacialists of the day stimulates the committee to renewed exertions to satisfactorily complete their work. The chairman of the committee is Professor L. C. Miall, F.L.S., &c., Leeds; vice-chairman, Mr. C. D. Hardcastle, Leeds; and secretary, Mr. S. A. Adamson, F.G.S., 52, Wellclose Terrace, Leeds.

The Yorkshire Fossil Flora Committee.

Respecting this committee, the eminent palæo-botanist, Mr. Robert Kidston, F.G.S., thus writes:—It was formed two years ago for working out the horizontal and vertical distribution of the fossil plants occurring in Yorkshire. It is well known that different series of rocks are characterised by their fossil contents, but little attention has been paid in Britain to the distribution of fossil plants, either in space or time, and the committee has been formed for the purpose of gathering this information in regard to Yorkshire. The first part of the first report of the committee was handed in at the recent meeting at Hull, and consists of a record of all the species occurring as impressions in the coal measures of Yorkshire, as far as they are at present known. Already over 100 species have been recorded, and of these many are now known to be British for the first time. Evidence of several other species was also seen, but on specimens too imperfect to admit of a satisfactory determination; of these it is hoped that better examples may yet be discovered. The committee feel sure that continued investigation will much increase the present list, which must be regarded as only a provisional one. From many districts in Yorkshire the committee have received practically no records, on account of the want of workers in those areas, and they now take this opportunity of asking all Yorkshire geologists and botanists to assist them in every possible way, and, if they know of any collection of fossil plants, or themselves possess any, to communicate with the secretary to the committee, who will gladly furnish additional information upon the matter.

The following notes may be of use to those who may be willing to assist the committee, and their attention to them would much lessen the work of Mr. R. Kidston, F.G.S., of Stirling, who has undertaken to examine the specimens:—

1. As soon after collection as possible, label all specimens, stating—
   (a) Full locality, giving name of pit, if collected at a colliery.
   (b) Giving horizon (*i.e.*, the name of the coal seam with which the shale was associated that contained the fossil, or any other particulars that will enable the exact position of the rock to be determined from which the fossil has been derived) when ascertainable.
   (c) Name of collector.
2. Collect all specimens, however small or uninteresting they may appear, and give great care to the collection of all fructifications, even when fragmentary, whether cones or fruit of ferns.
3. On no account varnish the specimens, and, if absolutely necessary to apply some preservative medium, use very weak, watery glue, and apply it by "dabbing" gently with a soft sponge. It need hardly be added that all fingering of the surface of the specimen, or rubbing of any kind, ought to be avoided. On collecting wrap the fossils singly in paper at once, to prevent their being scratched or the carbon displaced whilst carrying them home. In mending broken specimens gently heat each part before applying the glue.
4. In packing fossils for transit wrap each separately in paper, and pack with additional paper, straw, hay, or shavings in a strong box. Never use sawdust, husks, or any similar substance for packing.
5. All specimens sent for examination to be numbered, and accompanied with a list containing the numbers, localities, and any other additional particulars that may be thought necessary.

The second part of the report, dealing with the species which have been named from characters derived from their internal organisation, is in course of preparation.

The chairman of this committee is Professor W. C. Williamson, F.R.S., and the secretary is Mr. Wm. Cash, F.G.S., 38, Elmfield Terrace, Halifax.

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The Yorkshire Coast Erosion Committee.

A committee of the British Association is appointed to inquire into "the Rate of Erosion of the Sea Coasts of England and Wales, and the Influence of the Artificial Abstraction of Shingle and other material in that action." As they truly say, the importance of this subject is universally admitted, and the urgent need for inquiry is apparent to all who have any acquaintance with the changes which are in progress upon our coast. The subject is a large one, and can only be successfully attacked by many observers working with a common purpose and upon some uniform plan. Hence the strong desire that the Yorkshire coast should be thoroughly examined, and the appointment of a committee for that purpose. As the Rev. E. Maule Cole eloquently remarks:—"Erosion of the Yorkshire coast is always going on, although unequally and somewhat fitfully. One cannot look at those Lias and Limestone scars and Chalk pavement, stretching out to sea far beyond low-water mark, without realizing that they are the bases of cliffs long since worn away, and that the present coast line is very different from what it was in the ages that are past. If this be true of comparatively hard rock, much more is it true of that softer material which fills so many pre-glacial valleys of the Yorkshire coast, namely, Boulder Clay. The greatest ravages on the coast are in those localities where the cliffs are composed of this clay." During the past year the honorary secretary has taken several measurements at different points on the cost, which will be placed on permanent record with the Yorkshire Naturalists' Union. Careful and patient observers on the coast are much wanted for this important work. They should communicate with the secretary. The chairman of the committee is Mr. J. W. Woodall, M.A., F.G.S., Scarborough, and the secretary is the Rev. E. Maule Cole, M.A., F.G.S., Wetwang Vicarage, via York.

The Yorkshire Geological Photographs Committee.

At the Newcastle-on-Tyne meeting of the British Association in 1889 a committee was appointed for the Collection, Preservation, and Systematic Registration of Photographs of Geological Interest in the United Kingdom. Photographs are desired illustrative of characteristic rock sections, especially those of a typical or temporary nature, railway cuttings, important boulders, localities affected by denudation, or where physiographical changes are in operation, raised beaches, old sea cliffs, coast scenery and coast erosion, characteristic river-valleys, escarpments and other landscape features, glacial phenomena, such as roches moutonnées, moraines, drums and kames, and natural views of geological interest.

Yorkshire, as every geologist knows, is singularly rich in opportunities for permanent records of the above character, and by the active assistance of Yorkshire photographers and geologists, a collection of photographic views illustrating the geology of our county could soon be made, a series invaluable to either professor or student. What Yorkshire has already done in this respect can be seen by referring to the provisional list of photographs which Mr. Jeffs presented at the meeting of the British Association at Newcastle, in which our county occupied a leading position.

The Yorkshire Naturalists' Union intend that by the appointment of a Yorkshire committee to work in conjunction with that of the British Association this ascendancy shall be maintained, and it is hoped that when the Parliament of Science meets in Leeds in September next this will be found to be the case. The Yorkshire committee is now at work with Mr. J. W. Davis, F.G.S., Halifax, as chairman; Mr. S. A. Adamson, F.G.S., Leeds, as vice-chairman; and Mr. J. E. Bedford, F.G.S., Clifton Villas, Cardigan Road, Leeds, as secretary. In order to assist and inform those who are willing to assist in the scheme, the secretary will gladly forward a schedule of instructions upon application.

S. A. A.

Museum Notes.

The new Ruskin Museum at Sheffield, now in course of construction, will be opened early in April. It is expected that the Earl of Carlisle will perform the inaugural ceremony.

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The fifth annual report of the Antiquarian Committee of the Museum of Archæology, Cambridge, has been presented to the Senate. It records a satisfactory increase in the attendance of visitors, and the presentation of five interesting carved stones (originals and casts) of early date, through Professor Browne. The most noteworthy additions of the year were a large series of stone and shell implements and ornaments from the West Indies, Natal, &c., presented by Colonel H. W. Fielden; and an ethnological collection from the Solomon and Banks Islands, presented by Bishop Selwyn. During the vacation, an excavation of an old Roman burial place and refuse-pit, at the Isle of Alderney was undertaken by the Curator (the Baron Von Hugel), which occupied six weeks, and resulted in the acquisition of a great quantity of pottery, bricks and tiles, glass, bronze finger rings, &c., pointing to a large and permanent Roman settlement in the island.

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It is proposed to open the Queen's Park Museum, at Manchester, in the evening during the winter months, and a sub-committee of the Parks and Libraries Committee of the Manchester Corporation has been appointed to consider the matter and report thereon.

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Our useful contemporary, *The Library*, gives in its February number a note on the Tudor books lately exhibited at the British Museum. Among the collections are several MSS. and printed pamphlets of the reigns of Henry VIII., Edward VI., and Mary. Most of the Elizabethan books are concerned with the Queen's triumphal Journeys into London, Norwich, and Killingworth (or Kenilworth) Castle. The literature of the age is also represented by a large collection of funeral ovations and elegies to the memory of Queen Elizabeth.

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The Monday evening lectures at the Liverpool Museum are being continued. During February the following lectures, among others, have been given:—"Birds of Paradise," by Mr. G. J. Hill; "History of a Piece of Slate," by Mr. J. Lomas; "The Formation of Agates and the uses to which they are put," by Mr. F. P. Marrat, largely illustrated from his own and the Museum collections.

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Mr. T. Tarleton also lectured in the Mayer Museum at Liverpool on "Relics of Funeral Customs." Beginning with the very rudest methods of sepulchre, the lecturer traced the origin of many of our existing customs to barbarous times. The method of the Parsee, who consigned his dead to the "Tower of Silence," was compared with that of the Egyptian and his mummy, and it was incidentally pointed out that few customs are more prejudicial to health than those which obtain in regard to funerals at the present day.

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A demonstration by Mr. W. E. Hoyle, M.A., took place at the Owens College Museum on the subject of "Deep Sea Life," with illustrations by the lime-light.

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Under the presidency of Professor Boyd Dawkins, F.R.S., a special meeting of the Manchester Geological Society was held in the Geological Museum at Owens College, when Mr. Mark Stirrup, F.G.S., gave an address on the "Hydrology of the Causses of Languedoc," a locality in the heart of the Carennes mountains, situated in the south of France. The term "Causses" was a derivation from a Latin word, being a local name for certain calcareous plateaux, ranging from 2,600 feet to nearly 4,000 feet above the sea-level. Views were shown of extraordinary caverns and formations found in the vicinity in the course of some explorations which are being carried on.

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The exhibition galleries of the British Museum are now opened on week-day evenings between the hours of 8 and 10 o'clock. On Mondays, Wednesdays, and Fridays it has been arranged to open the galleries of

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the Library, of glass and porcelain, prints and drawings, and the Asiatic and mediæval collections; and on the remaining evenings of the week the galleries of sculpture and other antiquities will be available for inspection by the public. On the first night, within five minutes from the time of opening, there were stated to be from 400 to 500 persons in the building. This fact speaks well for the success of the new departure.

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In the installation of the electric light at the British Museum galleries an important improvement has been effected. Both arc and glow lamps are used, the current for which is generated by four Siemen's dynamo machines. Great satisfaction has been expressed by students and visitors at the new lighting arrangements, by the aid of which many of the sculptures and other objects can now be even better seen than in ordinary daylight.

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Now that the museum is open in the evenings, a desire has once more been widely expressed for the acquisition of a descriptive catalogue of the collections. Some such guide or cheap handbook as is provided for several departments of the new Natural History Museum, Cromwell Road, South Kensington, would be a boon to those whose knowledge of the ethnology of the Egyptians is not greatly assisted by staring at statues or mummy cases with illegible inscriptions. Something more than the scant information afforded by labels is required by the general visitor; besides which a popularly-written and entertaining handbook would often be valued for purposes of reference, or even as a souvenir of a visit to the British Museum.

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What, however, is really wanted, and is of more importance than a catalogue, is the attendance of a well-informed *cicerone* who would give brief but explicit *viva voce* explanations of the various objects to visitors. We have before referred in Museum Notes to the want of such assistance, and reference to the matter has also been made in several newspapers. Among these, the *Globe*, referring to the evening opening of the British Museum, gave utterance to some sensible remarks on the subject, which, as they have an equally useful bearing on many other similar institutions, we take the liberty of quoting, as follows:—

It may fairly be assumed that of those who visit the galleries a very large percentage will belong to the uneducated classes—the classes to whom the details of art and archæology are necessarily unknown. What are these likely to make of the various objects to which they find themselves introduced? The information given on labels is never—and necessarily so—very elaborate or substantial, and without information, how can the exhibits be properly appreciated? No doubt the contents of the galleries are calculated to arouse even in the most ignorant breast a feeling of wonder, and possibly of admiration, but the sensation can be only of the vaguest; of lasting utility and benefit there can be next to none. Nor is it a question of turning the museum into a gigantic opportunity for object-lessons. We are no advocates of constantly aiming at the mingling of amusement and instruction. But, in this case, it is only by instructing the unlettered visitor that he can be rightly entertained. If he does not understand what he sees, he cannot enjoy it—save, as we say, in the vaguest and least lasting fashion. On the other hand, a competent *cicerone* would unfold to him much which could not but be fruitful, not only of present pleasure, but of a desire to go straightway and find out more for himself.

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By an order of the Librarian of the British Museum letters and telegrams addressed to readers at the "Reading Room" are now refused at the entrance, instead of being allowed to be delivered as formerly.

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Dr. Roderburg, of Lowen, Belgium, has patented a new method of preserving butterflies and natural history objects, enabling them to be preserved in cases or albums and transported or taken out for examination without injury. The object, having been first covered with gelatine, is then coated with a hard, colourless, drying or siccative varnish, which is said to protect both the object or specimen and the gelatine from the injurious action of moisture, mildew, or insects.

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Several curators of provincial museums have applied for specimens of the curious "mummified cats" recently imported from Beni Hassan, Central Egypt, into Liverpool, ex s.s. "Pharos." The cats, which were more or less in a fragmentary condition, and despoiled of the wrappings of cloths which the piety of the ancient Egyptians, some 2,000 or 3,000 years ago, caused to be placed round them, are to be ground up for the purposes of "bone-meal" manure. A few good, fairly perfect specimens have been secured for the Liverpool Museum. It is well known that cats were held sacred by the old Egyptians, by whom, after death, they were embalmed and deposited in subterranean cemeteries.

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The bones of the cats were put up to auction at Liverpool, when they realised £5 17s. 6d. per ton. Separate specimens of the heads fetched prices ranging from 2s. to 3s. 6d. each. Several persons who had not seen them imagined that they were all complete bodies of cats "mummified," instead of being fragments. One enthusiastic collector of "curios" wrote asking if the creature were in its original coffin!

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Bootle Free Library Lectures.—Mr. R. K. Dent, librarian of the Aston Manor Free Library, near Birmingham (author of *Old and New Birmingham*), delivered a lecture on "Devonshire: Historic, Legendary, and Picturesque." The discourse was of the most interesting character, and was illustrated by an attractive series of lantern views. The lecture, included copious extracts from Blackmore's delightful romance, *Lorna Doone*, and an excellent summary of that popular work, which abounds with descriptions of the charming scenery traversed and pourtrayed, was also interspersed with appropriate poetical quotations. Kingsley's delightful works, such as "*Westward Ho!*" were freely quoted from. In the Plymouth section the story of the Spanish Armada was graphically told again, the historic "game of bowls" on the famous "Hoe" not being forgotten, the whole narrative realising its old charm on the feelings and sympathies of the audience. The Chairman of the Free Library, Mr. Councillor Vicars, who showed his strong interest in the institution over which he presides by taking the chair, though scarcely able from illness to do so, in moving a vote of thanks to the lecturer, expressed a hope, shared by all present, that Mr. Dent would again favour them with a lecture during the next winter course.

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At the Grosvenor Museum, Chester, a lecture was recently delivered by Mr. R. Newstead, the Curator of the Museum, on "The Heron, and Heronries of Cheshire and North Wales." After dealing with the geographical distribution of the heron, its habitat, food, and anatomy, a short description of its local breeding places was given. These heronries are becoming fewer and fewer; out of a list of twenty-nine in the localities dealt with in the paper, twelve are now extinct.

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It is highly desirable that records of the heronries should be preserved. Mr. Newstead has collected much information of historical interest respecting them, but, with a view of making the record as complete as possible, he would be glad if owners of heronries, or those interested in the matter, would kindly send him any facts or information of which they may be in possession, with a view to publication. Communications should be addressed to Mr. Newstead, Grosvenor Museum, Chester. Further information is specially desired on the following heronries:—In Cheshire: Tabley Park, the seat of Lord de Tabley; and Sherrington, the seat of Lord Killmurry. In North Wales: Baron Hill, Plas Newydd, Penrhos, Anglsey; Pennant, Denbighshire; Eglwys Fach; Peniarth, near Towyn; Talgarth Hall, Merioneth; Rug, near Corwen; Plas-y-Wern, near Ruthin; and Flint.

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Dust in the Air.

By Dr. McPherson, F.R.S.E.

About a year ago we gave in these columns a full description of the marvellous apparatus invented by Mr. John Aitken, Falkirk, for the enumeration of the inorganic particles in the atmosphere. He was led to its construction by the discovery of the necessity of dust-particles as free-surfaces in the formation of fogs, mist, or rain. He took a cubic inch of the air to be examined and introduced it into a thousand cubic inches of clean filtered air; this mixture was introduced

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into a glass cylinder, near the top of which was a small square of silver, burnished in one direction, and divided into a hundred equal squares. By a stroke of the air-pump the air in the cylinder became rarified, and water-vapour rose from the surface of some water at the bottom of the cylinder. At once the dust-particles seized this water-vapour, and fine rain was produced. The rain-particles fell on the silver stand, and by means of a magnifying glass the number falling on any square could be counted. By a simple arithmetical calculation the proportionate amount in the tested air could be counted.

Mr. Aitken has during last summer been examining the air in different parts of the country, and has lately sent up an instrument with Mr. Rankine to the top of Ben Nevis. The results he has just communicated to the Royal Society of Edinburgh. At Hyères he found that the number of particles in a cubic inch varies from 60,000 to 1,200,000, the latter being taken when the wind was blowing from Toulon. At Cannes the lowest observation was 75,000 to the cubic inch, when the wind was blowing from the mountains; and the number went up to seven millions when the wind was blowing from the town. Sea-air was next examined. At Hyères it was found to contain 90,000; at Mentone a quarter of a million, with a steady wind from the sea; and at Cannes half a million, when a land breeze was blown back from the Mediterranean. In Switzerland the air was found remarkably free from dust. On Mount Righi at Lake Lucerne some of the observations showed as few as 10,500 particles in the cubic inch; and he was of opinion that to that absence from dust a good deal of the brilliancy and transparency of the air in Switzerland was due.

He next tested the air on the Eiffel Tower at Paris. The numbers varied considerably, from 11,300 up to 5,000,000, at the top. In the former case a heavy rain cloud passed over the tower; the rain beat down the city air, and brought the pure air to the top. At the base the number of particles in the air was double that at the top. He again made observations in Scotland. These tended to show how extraordinary was the pollution in the air due to human agency. Away from human habitations the minimum seemed to be 10,000 particles in the cubic inch of air. But as he approached villages the number increased; near towns the particles were counted by millions.

Of all his observations Mr. Aitken has never found less than 10,000 dust-particles in a cubic inch of air. The question is, whether that is the lowest limit which the atmosphere ever attained to? How much of that, also, is due to cosmic dust? And how much to human pollution? The millions of meteors which are dispelled into dust in our atmosphere every day keep up a full supply of cosmic dust, which reaches even the higher atmosphere.

As to the effect which the presence of dust in the air had on its transparency, he was of opinion that the dust began to condense moisture before the air was saturated. The dust-particles, by condensing the moisture in the air, increased in size, and so reduced the transparency. There was no doubt that a great deal of haze was nothing more than dust. He had observed that in the great majority of cases there was an over-abundance of dust during anti-cyclonic conditions. Strange is it that wind and dust curves are in precisely opposite directions! When he tested the air during a fog he found in all cases a large quantity of dust. His explanation of fogs is that calms increased the quantity of dust in the air. The dust increased the radiating power of the air, which soon got chilled to the condensing point, when fog was formed. Accordingly the greater frequency of fogs in towns seemed to be due to the greater amount of dust in the air, so that a fog may be looked upon as a suspended dew. He is now engaged in investigating the effect of dust and transparency on the temperature of the atmosphere. A good deal of discussion followed the communication on the part of Sir William Thomson, Dr. Buchan, Lord Maclaren, and others. This showed the intense interest which this subject of dust in the air has occasioned during the last few years.

Our Portrait Gallery.

XIX.—PROFESSOR JOHN W. JUDD, F.R.S., F.G.S., &c.

JOHN WESLEY JUDD was born at Portsmouth on the 18th of February, 1840. Before he reached the age of eight, however, his family removed to London, where he received the rudiments of his education. At a very early age he manifested a strong taste for the study of science, astronomy and geology being the subjects which specially engaged his attention. While still a schoolboy he constructed a telescope and other instruments, by the aid of which he made himself familiar with the appearance and movements of the heavenly bodies.

After leaving school some years of his life were devoted to the work of teaching, and, obtaining an appointment in the little town of Horncastle, in Lincolnshire, he was led to the study of the geology of that county, of which comparatively little was then known. But in 1863 his passion for science led Mr. JUDD to give up all other pursuits, and to enter as a student in the Royal School of Mines. This course he took in accordance with advice received from Professor (now Sir Andrew) Ramsay and Professor (now Sir Warington) Smyth, whose attention he had attracted in connection with the Geological and Mineralogical Examinations of the Science and Art Department. After spending rather more than a year in this school, he obtained an appointment as analytical chemist to one of the largest among the iron and steel works of Sheffield.

At the end of 1864, however, a serious railway accident which he met with caused a long interruption both to work and study, and came very near indeed to having a fatal termination. After many months of complete prostration Mr. JUDD, while slowly recovering his health, returned to his old haunts in Lincolnshire, and to the study of the strata of that interesting district; he spent some time, also, on the Continent in examining the foreign equivalents of the Lincolnshire and Yorkshire strata. The results of these labours appeared in a series of memoirs on the Neocomian formation of the North of England and its relation to beds of the same age in other districts. These papers were published in the *Quarterly Journal of the Geological Society*.

Mr. JUDD having, during these researches, made a geological map of the county of Lincoln, was invited to join the staff of the Geological Survey of England, and he did so in the year 1867. For four years he was engaged in the mapping of Rutland and the adjoining counties, and especially in investigating the relations of the Jurassic rocks of the South-West of England to those of Yorkshire. He had learnt from Mr. Sorby, during his short residence in Sheffield, in 1864, the methods and value of microscopic study when directed to thin sections of rock, and during

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PROFESSOR JOHN W. JUDD, F.R.S., &c.

From a Photograph by Mayall & Co., London.

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this period his leisure hours were largely devoted to petrographical investigations. The results of his labours on the Geological Survey appeared in his *Geology of Rutland*, a memoir which did not make its appearance till 1875.

His friend, the late Mr. Matthew Arnold, having obtained for him an appointment as an Inspector of Returns in connection with the administration of the Education Act of 1870, Mr. JUDD left the Geological Survey in 1871, and, for rather more than a year, again devoted his attention to educational work.

In 1872 he found himself free to commence what had long been the great project of his life—the study of the Secondary Strata of Scotland, and the investigation of their relations to the rocks amid which they make their appearance—a task for which his previous studies had given him an excellent preparation. During five years he concentrated the whole of his time and attention to these studies, his labours in Scotland being only interrupted by visits to the continent for the purpose of making the necessary comparisons between the British and continental types of the rocks and fossils. He was able to demonstrate how gigantic were the faults that must have affected the Scottish Highlands at a comparatively recent geological period, and, in addition to throwing much new light on the order and succession of the Triassic and Jurassic Strata of the district, he was able to show that the Carboniferous and Cretaceous formations, which had not up to that time been detected in the area, were represented by very remarkable and highly fossiliferous rocks. Still more striking was the evidence that he brought forward to show that during the Tertiary period five grand volcanoes, rivalling Etna in dimensions, existed in the West of Scotland. These investigations were the means of securing for Mr. JUDD the acquaintance, and subsequently the warm friendship, of Mr. Poulett Scrope, Sir Charles Lyell, and Mr. Charles Darwin, veterans in geological science who have now all, alas! passed from our midst. The result of these studies appeared in a series of memoirs published by the Geological Society.

In 1876 Mr. JUDD was appointed Professor of Geology in the Royal School of Mines, and shortly afterwards in the Normal School of Science, with which the older institution had been merged. Since that date, though his work in the field has been necessarily limited to vacation times, he has carried on his petrographical and vulcanological studies, the results of which have appeared in his *Volcanoes: What they are, and what they teach;* in his monograph on the Krakatoa eruption of 1883, and in a great number of papers published in different scientific journals. Many other subjects, such as that of the deep-seated rocks under London, the succession of Tertiary strata in his native district, the Hampshire Basin, the age of the celebrated Elgin sandstones and their remarkable fossils, and a number of mineralogical problems also engaged his attention and have been illustrated by his writings. His principal task, however, during the last fourteen years has been the inauguration and organisation of a scheme of practical instruction in connection with the study of mineralogy and geology.

His work on *Volcanoes*, to which we have referred, forms one of the most successful volumes of the International Scientific Series. It stands unrivalled as a popular and yet thoroughly scientific treatise, and is written in that graphic and lucid style which lends so great a charm to all Professor JUDD'S writings. .

Professor JUDD was elected a Fellow of the Royal Society in 1877, and during 1888 and 1889 he was a member of the Council of that body. Joining the Geological Society in 1865, he was elected one of its secretaries in 1878, holding that office for eight years, while during the two following years he occupied the presidential chair of the Society.

It will be apparent from this brief record of his career, that the exceptionally varied experience which Professor JUDD has enjoyed as a practical geologist, has not only enriched our scientific literature by the publication of some highly valuable original investigations, having an important bearing on the progress of geological science, but has also contributed, to a large extent, to the success which has accompanied his work as an educationalist. This department of Professor JUDD'S arduous labours is not the least important, or the least appreciated, as will be testified by the earnestness of the band of workers who owe to him their inspiration to the study of the earth's history as recorded in the rocks.

Notes in Brief.

AT the annual meeting of the Geological Society of London, held on the 21st ultimo, Dr. A. Geikie, F.R.S., was elected president.

A COURSE of eight lectures on Animal Physiology is being delivered by Professor Milnes Marshall at the Withington Town Hall.

IT is stated that a Committee of the Royal Society is about to be formed to investigate the entire question of Colour-Blindness and the efficacy of the various tests now in use.

PROFESSOR SEELEY, F.R.S., is continuing his annual course of winter lectures to the London Geological Field Class, which have met with great success. The lectures are being given on Saturday afternoons at Gresham College and deal this year with "The Tertiary Rocks on which London stands."

SHOALS of anchovies have lately visited the south coast of England, and the fish not being known to the fishermen, they were thrown back into the sea. This is hardly likely to have occurred if the real nature and value of the fish had been known. Mr. Cunningham, naturalist to the Marine Biological Station at Plymouth, states that some anchovies obtained from the pilchard fishermen are undoubtedly of the same species as those imported from France and Italy.

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ARTIFICIAL minerals are fast increasing in number. Professor de Schulten, of Helsingfors, has discovered a process, by evaporating a solution of carbonate of copper in carbonate of ammonia, for the manufacture of artificial malachite for ornamental work.

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DURING the past month meteorologists have been able to record some seldom-observed appearances in the sky. Halos, both of the sun and moon, and "mock suns," or parhelia, have been witnessed at many districts over England and Scotland, some of the appearances presented being very remarkable.

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MR. A. S. REID, F.G.S., also records the appearance of that rare phenomenon, a circular coloured fog-bow, at Glenalmond, Perth, in the centre of which the figure of the observer was projected, after the manner of the "spectre of the Brocken."

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THE unfortunate sparrows are in trouble again. At Old Weston, near Thrapston, in Northamptonshire, the farmers have started a fund for the extermination of these birds, which they are pleased to term "pests."

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SIR JOHN LUBBOCK, speaking at the Prize Distribution of the Keighley Institute, referred to the value of technical schools as a means of promoting the commerce and manufactures of the country, and advocated the alteration of the education code so as to permit and encourage manual instruction in our elementary schools. This could be introduced without injury to the literary subjects; in fact, rather to their benefit.

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CANON GREENWELL has been continuing an important series of investigations of the British barrows on the Yorkshire Wolds, commenced by him twenty years ago. The barrows on Folkton Wolds have yielded especially interesting discoveries. One of them was found to contain the body of a child, with which were associated three curiously ornamented objects, or utensils, made of hard chalk. The designs consisted of concentric rings or circles, with—in one case—incised dots, producing in conventional form the human face. No similar figure has hitherto been met with upon the pottery or other articles of the ancient British period found in Yorkshire.

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DR. R. C. JORDAN, in a communication to the *Standard*, calls attention to the rapid destruction of birds and plants now proceeding in Cornwall. The ferns are especially attacked; *Adiantum capileus-veneris* is apparently extinct, *Asplenium lanceolatum* (formerly abundant at the Lizard) now being very rare, and *Asplenium maritimum* is only to be met with in places nearly inaccessible. Handsome flowers, like *Inula Crithmoides*, are also becoming scarce. The lanes of Devon, too, once festooned with graceful forms, are now nearly bare, *Osmunda regalis* is fast disappearing from the Devon woods, and *Lathyras sylvestris* and *Vicia Bithynica*, once abundant on Teignmouth cliffs, are now almost extinct.

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THE reason for these losses to our local flora is to be found in the reckless manner in which roots of plants and ferns are gathered and hawked about for sale. We have ourselves seen, in the Isle of Man, the "Royal Fern" offered for sale by irresponsible boys who, if purchase was refused, grew tired and threw away the gathered roots. The remedy which Dr. Jordan has to suggest in the case of plants is that botanists should secure a small plot of land in the vicinity of the original habitat, where the rare and local plants could be strictly guarded and preserved. Doubtless naturalists might do much to prevent this wholesale destruction if they would act in concert, but we fear that "collectors," miscalled "naturalists," are often largely the cause of the depredations.

AT a conference specially called in Sheffield to consider the Technical Instruction Act, it was resolved to memorialise the Council to put the Act into operation.

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THE first volume of Professor Thorpe's *Dictionary of Applied Chemistry* is now ready. The work is in three volumes, and treats specially of chemistry in relation to arts and manufactures.

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IT has been proposed to establish an international memorial to the late Dr. Joule. A committee has been appointed, with Sir Geo. Stokes as chairman, Mr. John Evans as treasurer, and Sir H. E. Roscoe as secretary.

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FEW astronomical subjects have given rise to more discussion than the temperature of the moon. The latest pronouncement on this point is that of Mr. S. P. Langley, who comes to the conclusion that the mean temperature of the moon's surface when exposed to the sun does not exceed the freezing point.

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"THE Evolution of the Horse" was the subject of a series of lectures delivered at the Royal Institution by Professor W. H. Flower, F.R.S. Recent researches have all been confirmatory of the prophecy of Professor Huxley, that the evolution of the horse would be so far worked out as to prove a sort of test case of the value of the Darwinian theory.

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THE prizes and certificates of the Chester School of Science and Art were distributed by the Duchess of Westminster. Dr. Stolterfoht submitted the annual report, which stated that there had been 516 students during the year, being an increase of 21 on the previous year. The total number of certificates gained was 371.

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A NEW branch-library has been opened at Kensington, Liverpool. It comprises about 7,000 volumes, including the most useful scientific and classical text-books, and a collection of 300 volumes of standard music. Valuable assistance has been rendered to the committee by the superintendent librarian, Mr. P. Cowell, whose experience in books and matters relating to library work could not be excelled.

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THE following are among the most important of the prizes of the French Academy of Sciences for 1889. An extraordinary prize of 6,000fr. for a work calculated to increase the efficiency of the French naval forces has been divided in equal portions between M. Caspari, a hydrographical engineer; M. Clauzel, a naval architect; and M. Degouy, a naval lieutenant of the High School of War. M. Caspari's work is a clear practical treatise, in two volumes, for the use of sailors engaged in geographical operations. He also gives a new method for calculating the hour by equal altitude of two stars, and several other novelties. The Montyon prize in mechanics has been awarded to M. Eiffel for his various metallic erections; and the Plumey prize to M. Widmann for his study on the principles of machine construction. The Janssen astronomical prize has been given to Mr. Norman Lockyer, who is a corresponding member of the Academy. The La Caze prize in physics has been awarded to Professor Herz, of Vienna, for his recent electrical researches. M. Bréal, of the Museum of Natural History, has obtained the Desmazières botanical prize for a memoir on bacteria in roots. The Vaillant prize in agriculture fell to M. Brilleux, for a memoir on the diseases of cereals. Other prizes have been awarded for a treatise by MM. Kelsch and Kiener on the diseases of hot countries, in particular dysentery and kindred maladies; for a memoir by Messrs. Gad and Heymans on the influence of temperature upon the function of the muscular system; and for a study by Mr. Drake del Castillo on the flora and fauna of Polynesia.

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An excellent treatise on "The Marine Transport of Petroleum," by Mr. Geo. Herbert Little, editor of the *Liverpool Journal of Commerce*, has just been published by Messrs. E. & F. N. Spon. A work of this kind has for a long time been in great request by ship-owners and merchants and officers of petroleum-carrying vessels, and the present production contains a mass of technical and general information which will be of value to all who are interested in this increasingly important trade.

In the twenty-eighth annual report of the Liverpool School of Science and Technology, the committee state that 1,036 students have attended the classes during the year. The pass lists showed fewer successes than the previous year, and the grants earned thereby had suffered diminution. The impetus now given to the movement by the enactment of the Technical Instruction Bill of 1889, and the spirit with which the Liverpool School Board were preparing to put the Act in operation, would produce a beneficial effect upon the work which the committee had for so many years prosecuted successfully, though in the face of numerous, and often grave, difficulties.

Whilst so much senseless agitation is being manifested against the operation of the recent dog-muzzling order, it may be useful to refer to the Duke of Westminster's protest against a report, opposed to the muzzling of dogs, presented by a sub-committee of the Cheshire County Council. The Duke wrote that a great mass of scientific opinion was in favour of muzzling. Science had proved that hydrophobia was not spontaneous, but was contagious. The disease was increasing in England, and surely, dogs could suffer some trifling inconvenience to prevent infinite misery and horrible suffering. What was wanted was a law for general muzzling in these islands for eighteen months, and against all importations.

Foreign Jottings.

The celebrated astronomer, Struwe, director of the Imperial Observatory in St. Petersburg, has resigned his post.

A magnificent stalactite grotto has been discovered near Halle, in Westphalia, being nearly 100 metres long.

Advices from Iceland state that the earthquakes of last November were far more serious than at first reported. The shocks were felt along the whole south-west coast. The winter has been mild but stormy.

On January 31st, at 4-30 p.m., a shock of earthquake was felt around Umea, in Northern Sweden, going from east to west, and causing houses, &c., to shake.

It is proposed to erect a statue in France to Boussingault, the founder of agricultural chemistry in that country, and a public subscription, under the patronage of M. Pasteur, has been started with that object.

Botanical research in America has been aided by a munificent bequest from Mr. H. Shaw, who left a sum of from three to five million dollars to endow the Botanic Garden and School of Botany in St. Louis, Missouri.

The well-known Milanese astronomer, Schiaperelli, celebrated for his studies of the planet Mars, has informed the French Academy of Science that after ten years study of Mercury he has come to the conclusion that this planet has a rotation like that of the moon. The planet's rotation around itself as well as round the sun coincide, presenting thus always the same surface to the sun, just as the moon does to the earth.

A splendid meteor was seen at Flekkefjoid, on the west coast of Norway, on February 4th, at about 1 a.m., which exploded with a loud report. It was followed by a violent hail storm, which, however, soon was over. The report was like that from a cannon, and the flare could be seen for a long distance.

A new lake-dwelling has been discovered at Somma Lombardo, near Milan, under a peat-bog. Many of the posts are still standing upright. Some of the planks are half-burnt, having been made by splitting the trees by fire without using a saw.

By means of the Poetsch process of freezing the earth, a deep shaft has been successfully sunk in treacherous ground at the Chapin Mine, Michigan. Freezing pipes were put down, connected at the top, and filled with a solution of brine containing 25 per cent. of calcium chloride. In forty days a frozen wall of ice, earth, and stone, ten feet in thickness, was formed. The excavations were thus enabled to be proceeded with.

A remarkable deposit of rare minerals has been found in Llano County, Texas, where the fine masses of gadolinite were discovered in 1866. The region is composed of granite, in the veins of which ystrialite, gadolinite, black marlite, hyalite, and orthoclase are found. There is also a mound of quartz and red felspar, with veins of black iron-mica and thirty or more different varieties of rare minerals.

Last autumn we had experience in this country of some phenomenal hailstones. During a recent storm at Brisbane at the beginning of January, some hailstones fell which weighed nearly 5 ounces, and when picked up measured, according to an Australian paper, 8½ inches by 10¾ inches. The official report from the Brisbane Observatory states that one stone found in the Observatory grounds was nearly 4 inches long by 2½ inches broad, which is a respectable size, even for a hailstone.

Apropos of the Antarctic expedition to be undertaken by Baron Nordenskiöld next year, it may be of interest to state that already two years ago the Antarctic Exploration of the Royal Society of Victoria proposed such an expedition to the famous Swedish explorer, but the idea could not then be carried out for want of a suitable ship. However, last year the Royal Geographical Society of Australasia offered to contribute £5,000 towards such an expedition, which caused Baron Oscar Dickson, the well-known Swedish Mecænas, to offer an equal sum. The expedition will be equipped in Sweden, it being intended to select a vessel similar to the *Vega*, of north-east passage fame. More stress will be laid upon the scientific researches to be carried out than the attempt to actually reach the South Pole. Active preparations for the expedition are now being made.

A Russian Giantess.

That the race of giants, or, at all events, of giantesses, has not quite died out will be apparent from an inspection of the accompanying portrait, which we have been enabled to reproduce from a photograph of a young Russian lady who evidently occupies an exalted position in the world. Though Miss Elizabeth Lyska is only twelve years of age, she has already attained the height of six feet eight inches, and, if we are to place reliance upon the opinion of Professor Virchow, by whom she was examined, it is probable that this height will be considerably exceeded as she grows older. In comparison with her sister, whose portrait also appears in the photograph, and whose stature, together with that of her four brothers and sisters, comprising the family, is rather under than over the average height of Russians, Miss Lyska's development seems remarkable. Her body is well proportioned, though her hands and feet are quite twice the size of those of an ordinary full-grown woman. The colour of the hair and the facial

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features in no way differ from those of typical inhabitants of South Russia.

Similar instances of such development have been recorded, but they are rare. Probably the tallest human being of whom we have any authentic record in history was the Scottish giant of Frederick the Great, whose height is stated to have been 8 feet 3 inches. The mythical "giants" of olden days were super-human monsters, who were often credited with fabulous powers as well as fabulous stature: such ideas, in all probability, having had an origin in the discovery of the

huge fossil bones of some extinct mammalia. Modern giants, by which is meant men or women of marked stature above their fellows, do not seem to be confined to any race or clime. In every race of mankind a few isolated instances seem to occur where individuals depart from a certain mean, or average standard of stature. It has been noticed, too, that at each end of the scale the body does not bear the same proportion as in the normal type; for instance, the head of a giant or a dwarf is smaller or larger than if an average man had been magnified or diminished.

Examples of such abnormal growths are of great interest to the comparative ethnologist. To what extent the doctrine of heredity can be held to explain individual cases as they occur is highly uncertain. In the case now under notice no evidence is forthcoming, we are informed, that any of the ancestral members of this family were exceptionally tall. Mr. Galton has, however, collected so many examples of the sudden reversion to ancestral types where the existence of the particular stock which gave rise to the exceptional feature was either absolutely forgotten or difficult to trace. Science cannot satisfactorily explain these cases, which are too often merely regarded as "freaks of nature." It is worthy of note that Miss LYSKA's abnormal growth did not begin to be manifested until she was four years old, her growth being the most rapid during the fifth and sixth years. She is a very bright and intelligent child, and her mental faculties do not appear to have advanced, notwithstanding her stature, beyond the ordinary standard of her years.

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Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between January 16th and February 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	Highest (February 8th)	30·51	Inches
,, ,,	Lowest (January 23rd)	28·55	,,
,, ,,	Mean	29·889	,,
,, ,,	,, for 23 years January	29·920	,,
,, ,,	,, ,, February	29·921	,,
Temperature	Highest (January 16th)	57·0	Deg. F.
,,	Lowest (February 10th)	29·3	,,
,,	Mean	40·2	,,
,,	,, for 23 years January	39·1	,,
,,	,, ,, February	40·9	,,
,,	,, of Evaporation	37·9	,,
,,	,, ,, for 23 years January	37·5	,,
,,	,, ,, ,, February	38·7	,,
(*b*) Rainfall	Amount	2·406	Inches.
,, ,,	,, Mean for 23 years January	2·172	,,
,, ,,	,, ,, ,, February	1·687	,,
,,	Number of Days on which Rain fell	15	
,,	Greatest fall in 24 Hours (January 21st)	0·642	Inches
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·0	
,,	,, ,, for 23 years January	7·1	
,,	,, ,, ,, February	7·2	
(*c*) Wind	Velocity, Greatest (January 26th)	59	Miles.
,,	,, Least (February 6th)	2	,,
,,	,, Mean Hourly	19·6	,,
,,	Greatest Pressure on Square Foot (Jan. 26, 3-20 p.m.)	36·7	Pounds.
,,	Direction at time of Greatest Pressure	SW	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
21	130	127	78	151	164	34	39	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed one foot above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

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Bolton.

The Weather.

January 15 to February 14, 1890.

During the third week of January the barometric pressure was low and very unsteady, with strong south-westerly winds, on the 18th amounting to half a gale, and variable temperature. Hail and snow fell on the 20th and 21st, and thunder and lightning occurred on the 20th. On the 21st 1·21 in. of rain fell. The means for the week were: Barometer, 29·639 in.; temperature, corrected for daily range, 41·82°; humidity, 89·5%: total rainfall, 1·726 in.; sunshine, 6 hours 30 minutes; wind S.W. From the 22nd to the 28th pressure continued unsteady, accompanied by high winds, the anemometer indicating a distance of 606 miles travelled by the air during the 24 hours ending at 9 a.m. on the 26th, the wind blowing half a gale during the night of the 25th. From the 29th the barometer was high and steady. Rain fell on all the 10 days, hail and snow to a depth of 1½ in. on the 22nd, and snow 2 in. on the 27th.

Mock Suns.

A lunar halo occurred on the 27th, and on the 29th a solar halo, with "mock suns," was observed from 12·30 to 3·30 p.m. The latter phenomenon is regarded as presaging very stormy weather; in this instance it was succeeded by comparatively calm, high barometric pressure, and a period of 36 hours' drizzle. The halo, with prismatic parhelia, is caused by the refraction of the sun's light impinging upon the angles of minute crystals of ice in the upper atmosphere, the vapour having become frozen through such sudden changes of temperature as occur in the winter time upon the approach of a cyclone. The explanation of the phenomenon, and the absence of stormy weather succeeding, I venture to think attributable to the preceding long-continued systems of cyclones in Western Europe having broken up or detached some of these cold clouds containing ice-crystals, and these would produce locally similar atmospheric conditions as those which attend the approach of a storm; and, further, this hypothesis accounts for the drizzling rain, for, when the cold clouds came in contact with the warmer air near the earth's surface, they would precipitate themselves in the drizzling showers experienced here during the two succeeding days. The means for the last 10 days were:—Barometer, 29·672 in. (range 1·774 in.); temperature, 39·76° (range 13°); humidity, 86·9%; total rainfall, 2·437 in.; sunshine, 11 hours 20 minutes; wind variable.

During the month of January the barometer oscillated 23 times, and the mean was 29·808 in. Thermometers:—The mean temperature, 41·08°, was upwards of 3° higher than any of the preceding three years; the warmest day, 51·2°, occurred on the 7th, and the coldest, 27·18°, on the 3rd; the maxima of the month, 53·7°, occurred on the 6th and 7th, and the minimum, 21·4°, on the 3rd. Seven frosty nights. Relative humidity, 89%. Rain or snow fell on 27 days to the depth of 5·617 in., more than double the average. Amount of bright sunshine, 27 hours 30 minutes, or 11% of possible quantity, against 13 hours 15 minutes in 1889. The amount of ozone, 2·4 (scale 0-10), owing to the strong westerly winds, was also greatly above the average for Bolton.

The weather during the first week of February was settled; barometer high and steady; temperature ranged from 46° to 32°. The means:—Barometer, 30·293 in.; temperature, 39·48°; humidity, 89%. Totals—rainfall, 0·102 in.; sunshine, 11 hours 10 minutes; wind westerly, gentle breezes. On the 11th the anti-cyclone began to break up, with moderate easterly breezes, but during the whole week the weather remained fair, and temperature low and equable. Slight hoar-frost occurred on five nights. The means for the second week were:—Barometer, 30·157 in.; temperature, 34·61°; humidity, 84·4%; total rainfall, 0·02 in.; sunshine, 10 hours 20 minutes; wind gentle to moderate easterly breezes. W. W. Midgley, F.R.Met.S.

Met. Observatory, Bolton, February 19, 1890.

Sheffield.

Meteorological Summary.

January, 1890.	Temperature. Highest Max.	Date.	Lowest Min.	Date.	Mean* of Max. and Min.	Means for Jan. Daily Max.	Daily Min.	Rainfall. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date	Mean for Jan.* Ins.
Sheffield ...	55°	25th	17°	3rd	42°	—	—	4·07	22	1·28	26th	—
Spurn Head.	53°	25th	26°	3rd	41°	—	—	1·74	19	0·34	22d	—
York	57°	23rd	22°	3rd	42°	43°	33°	2·10	19	0·45	21st	1·88
Liverpool ...	57°	16th	23°	3rd	43°	44°	36	2·94	22	0·63	21st	2·23
Holyhead ...	54°	25th	34°	28th	45°	46°	39°	4·34	27	1·02	21st	3·49
Yarmouth ...	54°	25th	26°	2nd	41°	42°	34°	2·10	23	0·39	26th	2·06
Oxford	56°	25th	20°	2nd	42°	44°	34°	1·94	23	0·33	27th	2·33
London	57°	7th	26°	2nd	44°	45°	34°	2·11	20	0·27	28th	2·20

* The means of Temperature and Rainfall for January are for 15 years.

Pressure.

January 16, 1889, to February 15, 1890.

On January 16th a depression was travelling from the N.W., and pressure varied considerably, being down to 29·5 in. in the N.W., 30·1 in. in the S.E., and on the 17th it remained the same. On the 18th a further fall occurred, and pressure ranged from 29·1 in. to 29·7 in., and the fall continued on the 19th, the isobars being remarkably close and varying from 28·3 in. in the N. to 29·5 in the S. This was an unusually large variation of pressure over the British Isles, and was accompanied by severe gales. Pressure was steadily improving on the 20th, but fell again on the 21st and 22nd, when it was below 29·0 in. in nearly all places. On the 23rd a depression, with readings down to 28·5 in., was situated over the centre of the country, and on the 24th this had travelled eastward and pressure was quickly recovering. The barometer fell again on the 25th, but was rising on the 26th, when the isobars were again very close and the barometer readings ranged from 28·8 in. in the N. to 29·9 in, in the S. The recovery of pressure continued slowly on the 27th, and there was very little change on the 28th, pressure being somewhat irregular, but on the 29th it improved decidedly and the barometer was above 30·0 in. all over England. There was very little change during the next two days when the readings were between 30·1 in. and 30·4 in. On February 1st and 2nd the barometer was giving way, though still moderately high, and on the 3rd it recovered, being between 30·2 in. and 30·4 in. It continued high, with but slight changes, till the 12th when it fell to 29·8 in. in the W. and 30·1 in. in the E. The fall continued slowly on the 13th, 14th and 15th, the barometer readings on the latter date being 29·5 in. in the S.E. and 29·9 in. in the N.

The Weather.

In the week ending January 25th the constant succession of deep depressions as shown above produced violent gales on all the British coasts. Temperature was high and unsteady and rain occurred frequently, being heaviest in the west, and there were several thunderstorms. Rain fell on seven days at York and Oxford, six days at Yarmouth and London, and five days at Spurn, Sheffield, Liverpool and Holyhead, the rainfall at the latter place exceeding an inch on the 21st. During the early part of the week ending February 1st the weather continued very rough, but the wind gradually died down after January 27th,, and the weather became cold, dry, and bright, but towards the close of the week the weather became milder, and the air damp with drizzling rain occasionally. There was rain on seven days in London and Yarmouth, six in Liverpool and Holyhead, five at Spurn and York, four at Oxford, and four at Sheffield where, on January 26th, the rainfall exceeded 1¼ inches in fifteen hours. From February 2nd to the 8th the weather became much more settled, temperature became colder and more seasonable, especially in the south, and there was very little rain. Fogs occurred at times but a good deal of bright weather was experienced. There was rain on two days at Spurn and Oxford, on one day at Sheffield, Liverpool, Holyhead

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and London, but there was no rain at York. During the week ending February 15th the weather was fine and dry, with moderate winds, till towards the close of the week when it became unsettled, and snow and rain were experienced in considerable quantities on the 14th and 15th. Rain or snow fell on three days at Oxford and London, two at Sheffield, Spurn, York and Yarmouth, and one at Liverpool and Holyhead. Until February 14th the amount of snow that had fallen in Britain was remarkably small.

SUN SPOTS.

On January 18th there was a group of ill-defined spots to the N.W. of the sun's disc, and on the following day these showed as two distinct spots separated by a decided interval but on the same line. On the 20th these two spots had assumed a more oval form, and there was an elongated spot between, and almost connecting the two, the hindermost spot having its northern edge jagged. On the 22nd the sun was spotless, and remained so till the 31st when there were two spots to the N. of the disc, the first of which had an elongation in the direction of S.E., while the second was more circular and in a line with the first, but separated by a considerable space. Afterwards no spots appeared up to February 15th, though there were some bright facalæ on the S.E. limb on the 8th, but clouds prevented observations on the 9th, and on the 10th the sun was spotless. E. HOWARTH, F.R.A.S.

Museum and Observatory, Sheffield, Feb. 20, 1890.

Societies and their Work.

FOLLOWING upon the excellent examples of Birkenhead, Sheffield, and Birmingham, the Manchester Amateur Photographic Society have determined upon the institution of a photographic survey of their district, and arrangements with this object are now in progress. The survey will comprise a photographic record of every notable place, building, or view around Manchester. A committee has been formed and the different districts allotted to the workers. The two Manchester Photographic Societies have held exhibitions, that of the older—or "The" Society—being devoted to a comparative display of lantern slides by members. The "Amateurs'" exhibition was of larger scope, and included the work of their members in the various departments of their art.—At the last meeting of the Liverpool Amateur Photographic Society a discussion arose on the best lenses for detective work. It was stated that an ordinary French lens, working at E/11, with a rapid shutter, gave good results, especially when working with a lens covering the next larger sized plate than the one used (*i.e.*, a 5 by 4 lens for quarter-plate prints).

A successful *conversazione* was given by the Alford Naturalists' Society, at which a special feature was the exhibition of lepidoptera by Mr. E. Woodthorpe. Some interesting ornithological exhibits and notes were made by Mr. J. Cordeaux, M.B.O.U. The botany of the district was also well represented at this gathering.

Among Naturalists' Field Clubs in the provinces the club bearing that title established in Liverpool so long ago as 1860 still holds a first place. This club has lately held its thirtieth annual meeting, when it was reported that 321 members are now on the rolls, and that the average attendance at the ten field meetings held during the year (in addition to evening meetings) was 66. The President (the Rev. H. H. Higgins, M.A.) delivered an address entitled "Scenes, incidents, and impressions of travel from Alexandria to Sinai."

In an address to the members of the Leeds Naturalists' Club and Scientific Association, Mr. W. Clapham recently made some practical and useful remarks on the preparation and mounting of microscopic objects, directing special attention to the epidermis and stomata of vegetable tissue.

The Craven Naturalists' Association, of Skipton, has now a membership of 130, and is one of the most flourishing of the learned associations of Yorkshire. At a recent *soirée* was exhibited a large collection of bones, brought together as the result of explorations in the Elbolton Cave, conducted under the auspices of the society at the instigation of the Rev. E. Jones, of Embsay. In a "lecturette" this gentleman gave an eloquent account of the progress of the work of exploring this cave, which has revealed the positive existence of neolithic man in Yorkshire, besides furnishing corroborative testimony with respect to the discoveries of the Stone Age in North Wales and other places. Some excellent botanical collections (including a fine series of marine algæ) were displayed on this occasion. At a subsequent meeting of the Society the Rev. J. Gerard, of Stoneyhurst College, delivered a lecture entitled "Some Lessons of Field Observation," in the course of which he urged the value of original work by naturalists, who should not confine their labours to the mere collection of objects of natural history, but should weigh for themselves the theories they met with on all sides of contemporary literature.

A principal feature of a recent meeting of the Conchological Society was the exhibition of a large number of specimens of *Limnæa glabra*, by Mr. W. Nelson, who related his experiences of the species, which were directly opposed to the statement made by Rimmer that this creature is inactive and timid, and seldom floats on the surface of the water.

The Scientific Students' Society of Manchester has had a successful year, the work of which has comprised six evening meetings, two *soirées*, eleven afternoon excursions, six evening rambles, a visit to Paris, and six visits to museums. At the annual meeting Mr. Hy. Hyde read a paper on "Sponges," and at a subsequent meeting Mr. J. Birkenhead, of Sale, lectured on "Fern Culture in Towns."

A specimen of a moss—*Lejeunea rossettiana*,—new to Britain, was described at the January meeting of the Manchester Cryptogamic Society by Mr. W. H. Pearson. The locality of the "find" was Miller's Dale.

Professor Miall, of Leeds, who occasionally ventures forth abroad for the benefit of some local energetic society, gave a bright and "chatty" address to the members of the Manchester Microscopical Society at their annual meeting, taking for his subject the "Fresh-Water Harlequin *Chironomus*, and its Development." This organism is one of the most convenient for study in the comparatively foul waters of a manufacturing place, and its larvæ are found abundantly in the inky streams of Lancashire and Yorkshire.

The Wells Natural History and Archæological Society have been turning their attention to the progress of geographical research as evidenced by the journeys of Stanley in Central Africa, a paper on which subject was read by the Rev. Canon Buckle.

Acting on the view that a local society should inform its members as to all local exposures of rocks, the Liverpool Geological Society paid a visit to a boring, now in progress at Liscard, being made by the Wallasey Local Board. At Seacombe, near the "Great Float," Dr. Ricketts directed the members' attention to some large boulders, and to sections of the drift showing enclosed patches of sand. The ordinary meeting last month was devoted to a paper by the President (Dr. C. Ricketts) on the contorted schists of Anglsey, and to a lengthy communication by Messrs. P. Holland and E. Dickson, on an examination of the sediment from the river Arveyson, near the Glacier du Bois, in the valley of the Chamounix.

Owing to an attack of the all-pervading influenza, Mr. Lomas was unable to read his promised paper to the Liverpool Geological Association on "Natural and Artificial Glasses;" instead of which, the secretary, Mr. J. E. George, ever ready in an emergency, entertained the members by a vivid account of the Geology of the Isle of Wight. Mr. George and Mr. Hornell also lectured at the Museum on "Fossil Worms."

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The newly-formed Physical Society of Liverpool is doing well. The January meeting was interesting for its numerous exhibits of physical apparatus, among which was Professor Sylvanus Thompson's "spherometer" (shown by Mr. A. Norman Tate), an instrument for measuring the curvature of lenses. An excellent paper was read by Mr. C. H. Yeaman on "Sir Wm. Thompson's Electric Measuring Instruments," an abstract of which we hope to be able to give in an early number. At the February meeting several exhibits of physical apparatus were made; Mr. R. C. Johnson, F.R.A.S., read a paper on the "Results of the Last Total Solar Eclipse Observations;" and a discussion was continued on "The Theory of Cometary Phenomena," as stated by the Rev. F. Grensted.

The Chester Society of Natural Science have occupied themselves during the past month with the following papers, &c.:—"On Heredity," by Mr. E. B. Poulton, F.R.S.; "The Heronries of Cheshire and North Wales," by Mr. Newstead (referred to in our "Museum Notes" this month); "The Condition of the World in Relation to other Celestrial Bodies," by Mr. Lucas; "Translations and Their Value," by the Rev. C. L. Feltoe; "The February Sky," by Mr. W. Vincent. Mr. Poulton has arranged to deliver a course of six lectures at the Grosvenor Museum on "The Protective Value of Colour in Animals."

Reports of Societies.

Antiquarian.

The Newcastle Society of Antiquaries.—The seventy-seventh annual meeting was held in the Castle. The Earl of Ravensworth presided, and there was a large attendance. Several members were elected, and a number of books received. Dr. Hodgkin submitted the 77th annual report of the council of the society. It congratulated the society on the prosperity that marked its course. The number of members was 291, 21 of whom were honorary members, and 270 ordinary members. Many valuable papers had been read during the year, and interesting discussions had followed. The antiquarian work done by members of the society included the interesting excavations that have been made at the instance of Lord Armstrong at Cartington Castle and on the slopes of Simonside, and by Sir Wm. Crossman at Holy Island. The report regretted the loss the society had sustained by the death of its late treasurer, Mr. Wm. Dodd, and alluded to his literary labours in connection with the society. It suggested that the time had arrived when a new history of the county of Northumberland should be undertaken. On the motion of Dr. Bruce, seconded by the Rev. A. H. Adamson, the report was unanimously adopted. The report of the treasurer, submitted by Mr. John Philipson and Mr. S. Holmes, showed that the actual receipts during the year had been £435 8s. 9d. The expenditure was £371 14s. 5½d., and there was a balance in hand of £145 11s., compared with last year's balance of £81 7s. 10½d.

Biology and Natural History.

Entomological Society of London.—At the first meeting of the present session, Lord Walsingham, the president, in the chair, Mr. F. D. Godman exhibited a specimen of *Papilio Thoas* from Mexico, showing an aberration in the left hind wing. Mr. C. G. Barrett and Mr. W. H. B. Fletcher exhibited specimens of new or little known species of moths. Mr. H. Goss read a communication from Dr. Clemow, of Cronstadt, St. Petersburg, on the subject of the coincidence in 1510, 1757, 1763, 1783, 1836 and 1847 of exceptional flights and blights of insects and the epidemic of influenza. It appeared that 1889 was an exception to the rule, as no abnormal activity in the insect world had been recorded. Mr. G. A. T. Rothney communicated a paper entitled, "Notes on Flowers Avoided by Bees." A discussion ensued, in which Mr. Slater, Colonel Swinhoe, Mr. R. Trimen, and Lord Walsingham took part. Dr. D. Sharp read a paper on "The Structure of the Terminal Segment in some Male Hemiptera;" Colonel Swinhoe read a paper on "The Moths of Burmah;" Dr. F. A. Dixey read a paper on "The Phylogenetic Significance of the Wing-markings in Certain Genera of the Nymphalidæ."

Lancashire and Cheshire Entomological Society.—The meeting of the above society was held on Monday, 10th February, in the Liverpool Free Library, the president, Mr. S. J. Capper, F.L.S., in the chair. Dr. J. W. Ellis, of Stoke-on-Trent, for many years secretary of the society, was unanimously elected an honorary member. Mr. W. E. Sharp read a paper entitled "Contributions to the local Coleopterous Fauna," in which he enumerated 18 species of beetles which he had added to the local list since the publication of Dr. Ellis' *Coleoptera of the District*. The secretary read a communication from Mr. Robert Newstead, of the Grosvenor Museum, Chester, in which he stated that he had added seven new species of coleoptera to the district of Chester, mostly taken from wasps' nests. The secretary made some remarks on the damage done by lepidopterous larvæ to Irish linen while bleaching. Mr. C. H. H. Walker drew attention to the large size of the silk-producing glands of certain larvæ, illustrating his remarks by a blackboard diagram of the organ *in situ*, and also the epiploon, or fat gland, upon which he stated, in his belief, larvæ during hybernation, or skin-casting, were able to feed, and so sustain life. The president showed some beautiful varieties of *Spilosoma lubricepeda* and *menthastri*. Mr. Geo. A. Harker showed specimens of *Hesperia lineola*, a butterfly new to the British Isles, and pointed out the difference between it and the common skipper, *H. linea*.

Manchester Field Naturalists' Society. — The annual meeting was held in the Memorial Hall, Mr. Leo. H. Grindon, the president, in the chair. Mr. Alfred Griffiths, the secretary, read the annual report, which stated that the year's progress might be considered satisfactory, for the proceedings had been marked by smoothness, and the personal enjoyment of the members had been thorough. The excursions had been pleasant, and there was every reason to believe that much had been learned by all who set out with a view to exact observations. The society aimed not so much at the discovery of previously unnoticed facts in natural history, as at the acquisition of the simple and agreeable knowledge of the common objects of the country which was gained by rambles therein. The committee were glad to note, day by day, the extension of this taste, and the spread of this knowledge sufficiently rewarded the committee and the original promoters of the society for their labours. It would be remembered that one of the autumn evening meetings was given to the consideration of tree planting in towns, and that a sub-committee was appointed to see what could be accomplished in the way of promoting that very desirable object. The sub-committee had been diligently at work, and in due time would report. The election of officers for the ensuing year was then proceeded with, the result being as follows: President, Mr. Leo. H. Grindon; vice-presidents, Messrs. John Angell, W. Carr, G. W. Horsfield, and Joel Wainwright; botanical referee, Mr. Leo. H. Grindon; auditor, Mr. Joseph Lunt; secretary, Mr. Alfred Griffiths. Mr. C. J. Oglesby moved the following resolution, of which he had given notice:—"That to facilitate the working of the society sectional committees for the following departments be formed, namely, botany, archæology, geology, zoology, meteorology, and town gardening. Each of the sections to be controlled by two members of the society, one of whom, at least, shall be a member of the General Committee, and shall be recognized as referee. All proceedings of the sections shall be subject to confirmation and approval of the committee." He explained

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that this was no new feature in the working of the society, but was merely carrying out what was originally contemplated at the time of the inauguration of the society. The president afterwards gave an address upon "Celebrated Medicinal and Poisonous Plants," illustrating it with dried specimens of different varieties of plants.

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Chemistry.

THE CHEMICAL SOCIETY OF LONDON.—At a meeting of this society a paper was read on a "A New Method of Estimating the Oxygen Dissolved in Water," by J. C. Thresh, M.B. The process is based on the observation that whereas, in absence of oxygen, nitrous acid and hydrogen iodide interact to form iodine, water, and nitric acid; in presence of oxygen the nitric oxide becomes reoxidised, and, serving as a carrier of the oxygen, an amount of iodine equivalent to the oxygent present is liberated, in addition to that resulting from the initial action of the nitric acid; hence, deducting the amount liberated by the nitrous acid and by the oxygen dissolved in the solutions used from the total amount, the difference will be that corresponding to the oxygen dissolved in the water examined. The solutions used are:—(1) A solution containing ·5 gram sodium nitrite and 20 grams potassium iodide in 100cc.; (2) a solution of 7·75 grams sodium thiosulphate in 1 litre, 1cc. of which corresponds to 0·25 milligram of oxygen; (3) a clear solution of starch; and (4) diluted pure sulphuric acid (1 : 3).

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SOCIETY OF CHEMICAL INDUSTRY.—At a meeting of the Liverpool section, held at University College, Dr. Hurter in the chair, a paper was read by Dr. G. Schack Sommer on "Home-grown Sugar for Great Britain and Ireland." The author had made experiments in growing beetroot both in Wavertree and in the North of Ireland, and with most successful results, the beet as regarded its sugar-producing value comparing most favourably with that grown in France and in Germany. Dr. Schack Sommer also pointed out that from a financial point of view the growth of beet in this country would be a profitable industry, provided the necessary means were at hand to take up the manufacture of sugar therefrom, which did not exist at present. At the same time the disadvantage under which this country suffered in respect to the home production of sugar, owing to the continental bounty system prevalent, was referred to. The following conclusions were arrived at regarding the most favourable conditions for the growth of beet sugar:—1. The soil should be rich in mineral constituents, and free from sand. 2. It should have a deep foundation, and should be very equal in its layers. 3. The ground should be well drained. 4. Water is a necessity for the growth of beet sugar, but an excess is injurious. 5. Beet sugar cannot be profitably planted oftener than every fourth year. An interesting discussion followed, and a paper was also read by Dr. S. G. Rawson, in which he described two new forms of pumps which he had constructed; one of these was a much simplified form of the ordinary apparatus, but equally efficient; the other more complex but possessing several important advantages.

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Engineering.

THE INSTITUTION OF CIVIL ENGINEERS.—At the tenth ordinary meeting of the session, the President, Sir John Coode, K.C.M.G., being in the chair, the paper read was on "Bars at the Mouths of Tidal Estuaries," by Mr. William Henry Wheeler, M.Inst.C.E. The paper referred to the different kinds of bars, treated of causes of their formation, and suggested remedies for their removal. Four classes of bars were described, namely, those consisting of hard material not affected by the scour of the current; those due to deposit of alluvial matter brought down by rivers; bars consisting of shingle or sand; and casual bars. Examples of each kind were given.

LIVERPOOL POLYTECHNIC SOCIETY.—A meeting was held at the Royal Institution, Professor Hele-Shaw, president, in the chair. The hon. secretary read the annual report, which was adopted; and Mr. J. W. C. Haldane read a paper on "Liquid Fuel for Marine Boilers." He referred to the changes in the form of boilers, as, in the desire for economy, the pressure of steam employed was increased, and said the limit of efficiency was now nearly reached in coal-fired boilers, and that attention was being directed, as a further means of economy, to the use of liquid fuel. He described with the aid of drawings the apparatus in use in Russia on the Grazi Tsartzin Railway, and on the Great Eastern Railway in England, also apparatus used on steamers, and compared the various methods of injecting and burning the liquid fuel, the best method being apparently to inject air and oil into the furnaces by means of a jet of steam. Very high temperatures and a steady flame, capable of the nicest regulation, were obtained. In Russia liquid fuel was used upon hundreds of steamers and locomotives, but the use of liquid fuel would be advantageous everywhere, especially in ships, where about seventy per cent. of the coal bunker space could be saved and made available for cargo. He came to the conclusion that the advantages of liquid fuel greatly counterbalanced the disadvantages, and rendered it far superior to coal, even if the cost were double. An interesting discussion followed, an important point raised being the quantity of steam used in the jet, and the effect upon the boilers of ships navigating salt water of the quantity of salt water which would have to be fed into the boilers to make up for loss of steam through the jet. The proceedings terminated with a hearty vote of thanks to the author.

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Geology.

GEOLOGICAL SOCIETY OF LONDON.—At a meeting of this society on 22nd January, Professor Bonney read a communication on "The Crystalline Schists and their Relation to the Mesozoic rocks in the Lepontine Alps;" in which he gave the result of his investigations undertaken in July last in company with Mr. James Eccles. The paper, which was a lengthy one, and, with the ensuing discussion, occupied the entire evening, dealt exhaustively with the Andermatt section of crystalline white marbles; the schists of the Val Piora; the Ranchwacke, and its relation to the schists, and the Jurassic rocks containing minerals and fossils. Sections were described in which occurred indubitable belemnites and fragments of crinoids in a dark schistose and micaceous rock, full of "knots" and "prisms," resembling rounded garnets and ill-developed staurolites. These rocks at the Alp Vitgira appear to overlie, and in the field can be distinguished from the black-garnet schists. The matrix of the Jurassic schists is highly calcareous. The author believes much of the mica, and other small constituents to be derivatives. Incidentally, his observations indicate that a cleavage foliation has been produced in some of the Alpine schists anterior to Triassic times. The paper gave rise to some discussion, in the course of which Dr. Geikie read a translation of a letter he had received from Professor Heim, on the subject of the crystalline schists of the Alps.—On the 5th February, two papers were read on volcanic rocks. In the first, which was by Messrs. G. A. J. Cole and J. W. Gregory, the authors described "The Variolitic Rocks of Mount Genèvre," the eruptive rocks of which region are probably of past-carboniferous age, though their exact geological horizon has not been determined. The authors consider that the best modern representatives of the conditions that produced these rocks are to be found in the great volcanoes of Hawaii, and state that there is nothing either in their fundamental characters or mode of origin that cannot be paralleled among the products of causes now in action. In the second paper, Professsor J. W. Judd dealt with "The Propylites of the Western Isles of Scotland and their Relations to the Andesites and Diorites of the district," in the course of which he stated that by carefully following the much-altered rocks in the field to points where they retain some of their original

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characters, the propylites can be shown to represent various interesting types of andesite and diorite. The communications at this meeting were exceedingly technical, and as the president remarked, were "difficult to discuss—they required to be read and reflected upon."

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GEOLOGICAL SOCIETY OF GLASGOW.—The third meeting of the 32nd session was held in the Society's Rooms, 207, Bath Street, on Thursday, 12th December, 1889, Mr. Dugald Bell, vice-president, in the chair. Mr. James S. McLennan exhibited various specimens of interest from New Zealand, including "Petrified Moss," a deposit of vegetable fibres immersed in heated waters containing strong solutions of lime and generally found in or near hot springs. Also gold quartz from a reef worked at Cannibal Gorge, Reefton, Nelson. On the occurrence and distribution of the precious metal, Mr. McLennan made some interesting statements, remarks also being made by Messrs Young, Thomson, Glen, and other members. Mr. John Kissop exhibited from Holywood, near Kirtlebridge, Dumfriesshire, specimens of sandstone containing dark patches, caused probably by the presence of metallic oxides, and showing curious ring-like concentric bandings. Mr. D. C. Glen, F.G.S., exhibited a fine series of minerals in their crystalline forms, which he had obtained on a recent visit to the lake district of Cumberland. Amongst those represented were splendid examples of Baryta or Heavy Spar, Arragonite, Calcite in twin crystals, and quartz, some of the latter crystals being the most perfect he had yet obtained. The hon. sec., Mr. J. Barclay Murdoch, F.R.Ph.S.E, communicated an account of a bore recently put down for water at the works of the Thomliebank Printing Co. Ld., four miles from Glasgow, to a depth of 611 ft. 6 ins. Through the usual alternation of Blaes, Faiks, and thin beds of sandstone, limestone, and fireclay, the bore reached at a depth of about 200 feet, a bed of limestone about 7 feet in thickness, supposed to be the orchard cement-stone, and at 17 feet lower a bed of white sandstone. At 238 feet a heavy mass of sandstone was met with, amounting in all to a thickness of 118 feet and containing one part of white rock nearly 50 feet thick. This probably represents the Giffnoch sandstone now worked about a mile to the S.E. At a depth of 476 feet a second bed of limestone 7 feet 6 inches thick was reached, doubtless the Cowglen (Index) limestone. The strata below this were of no commercial or geological value and the bore was stopped at a depth indicated without having attained it object. Probably a dislocation of the strata through igneous action may have interfered with the passage of water, and another bore placed, if possible, on the other side of the fault might probably lead to a more successful result.——At the January meeting Mr. Robert Dunlop exhibited a series of finely-preserved fossil fish remains from a lately discovered bone bed in the Airdrie coal-field, including several undescribed species. The chairman, Mr. J. Young, F.G.S., read a supplemental note by himself, and by Mr. D. C. Glen, F.G.S., on the intrusive dolerite with tachylite veins, found in connection with the erect stems of fossil trees at the old quarry in Victoria Park, Whiteinch. It was stated that since the publication of their paper on the subject the authors had forwarded specimens of all the various igneous rocks found in the locality to Mr. Frank Rutley, F.G.S., lecturer on mineralogy in the Royal School of Mines, London, who had embodied the results of a microscopical examination and chemical analysis in a paper he had just read to the London Geological Society. In it Mr. Rutley gave a detailed account of the minerals present in the various specimens, and of the changes produced on them by devitrification and weathering. He agreed with nearly all the statements made by the authors in their former communication as to the truly igneous character of the intrusive rocks found at Victoria Park, where they came in contact with carboniferous strata. The hon. secretary, Mr. J. Barclay Murdoch, read on behalf of Mr. John Smith, Kilwinning, an exhaustive paper on "The Great Ice Age in Garnoch Valley, Ayrshire," in which the author gave a detailed account of the glacial phenomena observed by the writer for a number of years past in numerous sections and exposures, natural and artificial in the district under review, and it more especially recorded the results of a systematic study of them which he had made during the summer and autumn of 1889. Measurements of all the principal boulders, both of foreign and local origin, were given, with notes on their state of glaciation and probable sources from which they had been derived. Finally the author tabulated the conclusions to which he had been led. The paper was illustated by a series of beautifully drawn sections.

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LEEDS GEOLOGICAL ASSOCIATION.—At the January meeting of this Association a paper was read on "Fossil Fishes of the Chalk," by Mr. J. W. Davis, F.G.S., &c., of Halifax, who has achieved a well-deserved and widely-known reputation for his successful researches in this special subject. The notes in this paper apply only to those genera and species of Selachians from the chalk and tertiary formations having the asterospondylic form of vertebræ of Dr. Carl Hasse, and comprised in the family Lamnidæ, as most recently defined by Mr. A. Smith Woodward in the catalogue of the fossil fishes in the British Museum. The family comprises the following genera:—Alopecias, M & H, Cetorhinus, Blainv, Corax, Lamna, Cuv, Odontaspis, Ag. Oxyrhina, Ag. Seaphanorhinchus, A.S.W. Rhinognathus Davis, Ag. Carcharodon, M & H, Otodus. The following is an abstract of the paper:—

"The four or five species of sphenodus (known only by their teeth remains) are characterised by teeth having wide bases, with slender median crowns. They are found in the Jurassic rocks of the Continent, but have not yet been discovered in England. Alopecias is found in the eocene strata of Prussia. Cetorhinus occurs in tertiary strata at Antwerp, Italy, &c. Corax, known only by the teeth, are of world-wide distribution. The teeth have a central cavity. The teeth of existing fishes are hollow. The genus carcharodon is separated by Smith from the genus carcharias. The type of genus is carcharodon rondeletti, and microscopical examination has distinguished the two genera, carcharias having hollow teeth, and carcharodon solid ones. In the single existing species, C. rondeletti, the teeth are 1¼ in. long, and the entire length of the fish is 40 ft. The teeth of the tertiary representative of the genus C. megalodon are from four to five inches in length, and the fish must have been gigantic in size. C. rondeletti has teeth which are triangular, with serrated edges and without lateral cones or denticles. Agassiz included in the genus several forms having well-developed lateral denticles on their anterior and posterior borders, and although he noted the irregularity in form, he did not consider them of sufficient importance to found a new genus for their reception. The teeth of otodus are only known in the fossil state; they appeared to Agassiz to be intermediate between carcharodon, oxyrhina, and lamna. They resemble the latter in having lateral denticles, but whilst those of lamna are cylindrical and sharp-pointed, those of otodus are larger, flat, and blunt. The microscope shows the teeth to be solid and massive, as in carcharodon. The genus first appears in the cretaceous, was abundant in the tertiary, but died out before the existing period. The genus oxyrhina includes one or two existing species; the type of the genus is O. spallanzani; the teeth are free from lateral denticles, have smooth margins, and attain a considerable size, conforming to the usual arrangement of sharks' teeth. The genus lamna (Cuvier) included several fishes since taken as types of other genera, as otodus, carcharodon, and oxyrhina; the character of teeth being like those of existing sharks, lamna cornubica may be taken as the type of the genus. Some naturalists have based their classification on external features, such as position of fins and the branchial arches, paying little attention to the form of skeleton or dentition. In some cases, as in lamna and odontaspis, a separation has been laid down on this account, although the teeth prove them to be very nearly related, whereas cetorhinus, oxyrhina, and carcharodon having teeth of great dissimilarity to lamna, are grouped in the same family. The teeth of lamna cornubica differ in form according to their position in the jaws; the crown of the tooth is high and cone-shaped with smooth margins, and single lateral denticles exist on each side of the cone. It somewhat resembles otodus and odontaspis, but the latter is often twisted, and its denticles are longer and more pointed. Lamna has only one denticle on each side, but in odontaspis there are frequently two, and occasionally three, on each side. Oxyrhina has no lateral denticles. There is some difficulty in distinguishing between lamna and otodus, as some intermediate species appear to bridge over the limits between the two genera. The genus odontaspis is represented by species still living. Another genus of the lamnidæ occurs in the chalk of Mount Lebanon, and was described by the writer (Mr. Davis) as rhinognathus. It forms one of the very few instances in which the body of a lamnoid fish with teeth in the natural position has been found in the fossil state. Dr. H. E. Sauvage, in 1872, described the fish remains in the cretaceous rocks of Sarthe. He states that in the young stages lamna has teeth without denticles, and

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that they only develop later in life. He quotes an observation from M. Pictet 'that the teeth in many instances vary more from different parts of the same mouth than their homologues in another species, and that this variation renders the difficulty of their interpretation great.' This observation applies with considerable force to lamna and odontaspis, the teeth of which closely resembles each other, but the fishes still existing enable the naturalist to study and compare them. The most profitable method of investigating fossil remains is by comparison with existing forms, and it is fortunate that all the genera are not extinct. Though the fossil forms far outnumber the existing ones, there are still examples of carcharodon, lamna, oxyrhina, and odontaspis. The position of fins and tail in the three former are so similiar as not to indicate any generic differences. Odontaspis differs from those named in the form and position of fins and tail to such an extent as to induce Sauvage to place it in a separate family; whilst, judging from the teeth alone, Agassiz and others have regarded them as only a sub-genus of lamna. Having regard to the remaining genera, lamna, otodus, and odontaspis, existing species of the first and last still remain, but no species of a living otodus has been discovered. Still, so many wonderful types of fish have been found by deep-sea dredging and more careful research during the last few years that it may not be impossible for new genera yet to be discovered. At any rate, until more reliable information is accessible it may best serve the purpose of the palæontologist to regard the dismembered fragments simply as 'forms' exhibiting certain tendencies of a more or less definite character. One of the principal difficulties appears to be that it is desired to make an extremely large series of fossils representing an enormous development of the selachians fit to a minimised series of living representatives which are rapidly dying out, and that sufficient credit is not given to the variety and number of the species which obtained during the ascendancy of the family. Accepting this view, it may be advisable to regard the teeth as forms representing members of the family and classify them accordingly. It scarcely seems necessary to suggest that the successive redistribution of species among existing or newly-devised genera is to be deprecated. The genera, as defined by Agassiz, embrace already a wide range of species, and have hitherto proved adequate. They are universally known and accepted, and have tolerably well-defined limits. Taking as types otodus obliquus, the existing species lamna cornubica and odontaspis ferox, the palæontologist will be able to group the ever-varying fossil forms around these centres, and though they may possess characters expressing relationship with more than one species, succeeding discoveries may show that these only express the connecting links of an unbroken line of evolutional development."

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Geography.

ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.—At a recent meeting of this society, the Duke of Argyll, president, delivered an address on the "Border-Lands between Geology and Geography." In Greenland he thought the confluence of the two sciences was complete. The existing surface there was a surface in perpetual flux. It was in itself at once the cause and the result of geographical configuration. It was to Greenland alone that they must look for any facts bearing on glacial phenomena prevailing universally over any very large area of the earth's surface. The interest of Greenland lay in this, that there we had a mass of ice with three special characteristics—first, that it was of enormous size; secondly, that it rested on a country which had a general rising slope up to an elevation of 15,000ft.; and, thirdly, that it was situated in so high a latitude that the melting seasons were very short. Two conclusions were forced upon them by recent exploration in Greenland. The first was that ice-sheets, even of the most enormous magnitude, and moving down slopes of considerable steepness, were incompetent to overflow to any distance any terrestrial surfaces, even those which constituted hollows or depressions below the level of the sea, and were still more incompetent to surmount any opposing elevations above that level. The second conclusion was that all those surfaces which they did overflow from excessive accumulations of snow upon mountainous elevations of the land must be exposed to glacial action all over, and must tend more and more to exhibit outlines completely rounded. With reference to our own country, he said that a long study of hill surfaces which exhibited every British form of glaciation had convinced him that every one of those forms was to be accounted for either by common small local glaciers following the contours of the existing hills and valleys, or else by floating ice grounding on hill-tops and lower ridges during a submergence of the land under a glacial sea to the depth of at least 2,000ft.

Microscopy.

WESTERN MICROSCOPICAL CLUB.—This club met on February 3rd, at the house of Mr. E. M. Nelson. The host took for his subject "Metrology," or the "Science of Measuring." Its great antiquity was first referred to, its probable birth-place being Egypt. The great pyramid is found to have a base whose sides are almost perfectly oriental; its height is to its perimeter as 1 is to π. Certain marks within a chamber of the pyramid, as well as the coffer therein contained, were supposed by the late Professor Piazzi Smyth to be standards of length and capacity. At present we have in England a splendid collection of instruments for precise and accurate measurement at Greenwich. Chief amongst these is the telescope used for determining the meridians and for fixing time. This instrument is mounted on trunnions not unlike the mounting of a cannon; it sweeps a plane defined by three points—the pole, the instrument, and the centre of the earth. The method whereby it determines the exact noon was minutely described. Reference was then made to the ingenious method of synchronising the conical pendulum of the standard clock. The static electric charge of the atmosphere is measured by allowing water to flow slowly from an insulated cistern; the drops passing through the atmosphere became electrified, and give an induced charge to the cistern, which is then measured. The earth's magnetic force, declination, and dip are all automatically recorded. A short account was given of the sextant, its gradual development, and the method of using it. Some curious old dials of the ring-form were exhibited. It is curious to find how close an approximation some of these gave to the true time. "Dialling" was at one time—before watches and clocks became common—a necessary and fashionable art. How immensely our clocks and watches excel those of our grandfathers through the various improvements of pendulums, escapements, and balances was pointed out. The measurement of very minute objects by caliper methods or by multiple screws was shown to be defective, Mr. Nelson considering that the ultimate measurement must be made by the microscope. In this an enlarged image of the object may be exactly measured at the eye-piece by a micrometer; this, by comparison with the image of some object whose size is exactly known, will enable the true dimension to be ascertained. Incidental reference was made to calculating machines, practical examples being given on an ingenious spiral slide-rule. Variety was provided by exhibitions under several microscopes of some test diatoms shown by the new apochromatic lenses in contrast with the best specimens of the old form of lenses. As a finale, photographic magnifications of these diatoms and other objects were shown on the screen by a triple-wicked lantern.

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BIRMINGHAM MICROSCOPISTS AND NATURALISTS' UNION.—At the meeting on January 20th, Mr. T. Hickin read a paper on "The Sun." After speaking of the solar system and its relation to its centre, the writer gave the dimensions of the sun and described its envelope, or photosphere, and the spots on its surface, with their movements. It was found that these spots varied in number over a period of eleven years. The peculiar appearance of the spots under high powers was described at some length. The red prominences seen on the sun during an eclipse were spoken of and their effect on the spectroscope shown. The subject was illustrated by a series of lantern pictures.—On January 27th, Mr. J. W. Neville showed specimens of Ammonites from Lyme Regis; Mr. A. Camm, *Clathroptychum rugulosum*, a fungus new to Mid-England, from Sutton Park; Mr. Lassetter, a series of Silurian fossils from Aldridge; Mr. G. Corbett, jaw and vertebræ of *Tichthyosaurus*, from Wilncote; Mr. H. Hawkes, fern spores in coal.——On Feb. 3rd, Mr. H. Hawkes exhibited a collection of New Zealand ferns, and a small collection of Indian flowering plants; Mr. Lassetter showed a specimen of *Gorgonia flabellum*.——On February 10th, Mr. J. Madison showed a peculiar form of *Anodon*, from the Warwick canal, the shell being so altered as to make the species uncertain; Mr. J. Collins, a

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white banded variety of *Limnæa stagnalis*, from Yardley; Mr. W. Dunn, a series of *Rotifers*.—On February 17th, Professor Hillhouse, M.A., F.L.S., delivered a lecture on "The Continuity of Protoplasm." After describing the vegetable cell, the lecturer showed enlarged models of the leaves of the sundew and Venus's flytrap, and explained their methods of catching insects. This necessitated the transmission of a stimulus from one part of the leaf to another. If our conception of a plant was a structure built up of isolated cells then these movements were difficult to account for; it was therefore surmised that there were intercellular relations before they were made out. It was only within the last twelve years this subject had been specially studied, and the results showed that the cell wall thinned in some parts and through these the protoplasmic threads passed.

General Science, &c.

NEWCASTLE LITERARY AND PHILOSOPHICAL SOCIETY.—The annual meeting of this Society was held in the lecture-room of the institution. In the absence of the president (Lord Armstrong), the Rev. Dr. J. C. Bruce presided. Professor J. H. Merivale read the annual report, which stated—

"The past year has been an eventful one in the Society's history. The long delay in the completion of the alterations and new buildings was at length terminated in May, and the members have since then had the advantage of the greatly-improved and extended premises. Considerable alterations have also been made in the laws of the Society. These were considered not only at the last annual meeting, but at special meetings held on April 2nd, April 16th, and June 4th. The new laws provide for a six months' membership, commencing from July 1st in each year, and associateship of the Society has been arranged for, and the Society's year is made to end on the 31st December, instead of the 31st January, so that the numerical statement with which this report generally opens does not give so accurate a comparison with last year as is usually the case. The year began with 1,123 members on the roll; 44 had been elected up to June 30th, and 41 have been elected since; 109 have resigned during the year. There have been 18 deaths, and 3 members have been struck off for non-payment of subscriptions, leaving the total number of members at the end of the year 1,078. But it must be borne in mind that this statement represents 11 months only, and that 20 associates have been elected since June. We may also mention that 29 members and 24 associates were elected in the month of January of this year (1890), so that there has actually been a slight increase in the membership as compared with last year. At the same time, considering that the Society now offers to all young persons under 21 years of age, as well as to the wives and unmarried daughters of members, access to its large and comfortable library and other rooms, and the right of borrowing books, as well as that of attendance at 48 lectures by university men, for the small subscription of half a guinea a year, the committee think that there should be a very much greater accession of members and associates than has hitherto been the case, and they strongly urge upon all who are really interested in the welfare of the Society to make its great and unusual attractions widely known. The financial statement of the Society shows a credit balance in the treasurer's hands of £126 18s. 3d. upon the general account. The building account has not yet been closed, as there are certain outstanding questions to be settled with the contractors. The Society had no provision for the furnishing of the new rooms and the redecoration of the old rooms, but the president, Lord Armstrong, with his wonted liberality, agreed to subscribe one-half of the estimated amount required. The committee appealed to the members to raise the other half, and it is satisfactory to be able to state that the appeal was liberally responded to, and the promised subscriptions have, with scarcely an exception, been already paid. The committee regret that Dr. Hodgkin, who has for 15 years acted as the Society's treasurer, has been obliged to resign that post, and they are sure that the members will join them in the hope that a colleague whose unfailing courtesy and literary distinction were alike conspicuous will continue to take an active interest in the Society. The work of preparing the new catalogue is progressing, and appended to this report are certain notes upon it and upon the new method of book-keeping adopted by the Society. The meeting of the British Association, alluded to in the last report, was duly held, and was very successful in every way, thanks in a great measure to the energy and ability with which Professor Merivale, one of the secretaries of this Society, performed the duties of honorary secretary to the local committee."

The librarian, Mr. Lyall, had prepared an interesting table showing the circulation of the books and magazines in the library during the last six years. The meeting then proceeded to the election of officers, which resulted as follows:—President, Lord Armstrong, C.B., LL.D., &c.; vice-presidents, John Clayton, F.S.A., Rev. J. C. Bruce, LL.D., F.S.A., D. Embleton, M.D., and J. W. Swan, M.A.; treasurer, C. J. Spence; secretaries, R. S. Watson, LL.D., and J. Herman Merivale, M.A.

YORKSHIRE PHILOSOPHICAL SOCIETY.—The annual meeting was held at York. The Rev. Canon Raine presided.—Mr. T. S. Noble (hon. secretary) read the report of the council. The balance-sheet disclosed a favourable state of things for the past year. No less than forty-three new subscribing members had been added to the society's roll. The total income had been £1,225, and the outgoings £1,257; but as the balance in the hands of the treasurer on the 31st December, 1888, was £31, and the excess of expenditure over income for 1889 was £31, a balance of 4s. 4d. remained in the hands of the treasurer on the 31st December, 1889. The report proceeded to describe the condition of the various scientific departments of the museum. The report was adopted, and the list of officers as recommended for election by the council was accepted.

Russian Exploration in Central Asia.

[FROM A ST. PETERSBURG CORRESPONDENT.]

THE Imperial Russian Geographical Society has just resumed its meetings, which are often of great scientific interest, particularly from the reports furnished upon Russian explorations in Central Asia, on the Chinese frontier, of which so litttle leaks out elsewhere.

As may be remembered, the aim of the famous Russian explorer, General Przevalsky, who just a year ago died at Karakul, where he lies buried, was to explore Thibet, and the Government had placed at his disposal ample means in order to accomplish this task. However, his death caused a temporary delay in the further penetration of his expedition into unknown regions, but the work was soon resumed. The new commander chosen is Colonel Pevtsov, well known for his travels in Mongolia, and under this officer the expedition shortly afterwards resumed its march.

The expedition was divided into three columns, the one directly in command of Colonel Pevtsov having for its object to penetrate into the heart of Thibet, whilst the right column, under Colonel Grourbtschevsky, and the left, under Colonel Grum-Grzymails, explored Hindukush and Gobi respectively.

The commander has as yet not furnished a report, but at the last meeting of the Russian Geographical Society one was read from M. Roborovsky, belonging to Pevtsov's column, dated from an oasis south of Jarkand.

It rained in torrents when the column broke up from Przevalsky's grave, and soon the fertile land around Karakul lay behind, the dreary Tian-Schan being in front as far as the eye could reach. The crossing of Kokschal-Than was attended with many difficulties, the mountains being still, in May, covered with deep snow. Men and camels became deeply embedded every moment, and frequently the loads had to be taken off the latter to enable them to get up and then re-load them. At times the expedition was in great distress, men and animals being completely knocked up, the weather being also very trying. At one moment the sun shone brilliantly and in the next it rained in torrents, followed soon after by a terrific snow storm. The weather often changed twenty times in as many hours.

An altitude of 12,000 feet had to be reached before a pass was found. However, the descent was easier, as the snow was not so deep on the southern slope, nor extended so far into the valley.

The great desert now lay before the expedition, which had to be crossed in the direction of Utsch-Turfau. Hence the road lay along the Tuschkan-Daria, often through ravines which presented as many difficulties as the crossing of Kokschal-Than, these being filled with small and large boulders, which had to be removed in order to enable the column to proceed. Progress was only made by the yard, and fifty days passed before Maral-Baschi was reached, a large district covered with great salt lakes and swamps. The natives met with were friendly and hospitable, and no sign of distrust or hostility was shown.

Soon after reaching Jarkand-Daria the expedition lost one man, a soldier, who, insisting upon bathing in the river, was instantly carried away by the swift current.

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The expedition then followed the river to the capital of the Sarters, Jarkand, in Eastern Turkestan, and the nearer this place was approached the more fertile and cultivated the land became. Already at a distance of fifty miles from the city the rice fields were so closely situated that there was a difficulty in pitching the tents.

The city of Jarkand is a double one, the true town being inhabited by the Mohammedan Sarters to the number of about 40,000, whilst the Chinese population occupy the part called Jangischar. The hous s are surrounded by gardens, in which vine, melons, and potatoes grow in great luxury.

The expedition, having now covered 600 versts through Kashgaria, remained for some time here resting after its sufferings, when the march was resumed for Khotan, where it goes into winter quarters. Early in the spring the march will be continued to Thibet. The heat during the summer was terrible.

The object of the expedition, as stated above, is to explore Thibet and its mysterious, almost unknown capital, Lhassa, the sacred city. Most of what we know of Thibet and its inner organisation is derived from the French missionaries, Hucs and Gabet's travels, forty years ago. However, the archives of the Indian Government contain much valuable information about the country, but its publication is not desirable, as Russia might derive advantage therefrom. On the other hand, it is more than probable that Russia has still more valuable and fuller details of the geographical and political conditions of the country in her possession through her numerous expeditions in the same.

Reviews.

The Civil Service Guardian and County Council Courier.—The February issue of this new journal (edited by Mr. Wm. Jas. Tate, and published at 5, Robert Street, Adelphi, Strand, London, W.C.), bears out the promise of the first number. It contains an abundance of readable matter, and items of news and comments on topics which cannot fail to be of service to those connected with the Civil Service or with the County Councils, just now so active in this country.

The Estimation of Minute Quantities of Gold. By Dr. George Tate, F.I.C., F.C.S.—In this little *brochure*, which, we note, is the reprint of a paper read before the Liverpool Polytechnic Society, Dr. Tate endeavours to show how minute a quantity of certain substances is capable of recognition, and how, by suitable means, such minute quantities as the one ten-thousandth, or even the one hundred-thousandth of a grain may be estimated with accuracy. It will, no doubt, astonish many to learn that with the aid of the microscope a far less quantity than the millionth of a grain of chemical matter can be recognised and identified with conclusiveness and its weight estimated with a fair degree of accuracy. In illustration of this, the author proceeds to describe his method of measuring small quantities of gold, under the microscope, with the assistance of a specially-constructed micrometer. This is an interesting operation and will doubtless be of value to geological science in enabling the precious mineral to be detected in weighable quantities in various strata where it exists and where the search for gold may be carried on. In the ordinary method the weight of a bead of gold is estimated from its diameter, obtained by placing the bead above a divided scale of two divergent lines. By employing the compound microscope, to largely increase the apparent size of the beads or "prills," and the addition of an eyepiece micrometer as a scale, a measurement is enabled to be effected of a high degree of accuracy, beyond that of the finest balance yet constructed.

Liverpool Marine Biology Committee. Third Annual Report on the Puffin Island Biological Station. By W. A. Herdman, D.Sc., F.R.S.A., Director.

Dr. Herdman has given us, in this report, a graphic account of the work which has been actively carried on at Puffin Island, resulting in an unusually large number of events and observations worthy of record. Especially do we note the development of the experiments with the submarine electric light (which the Liverpool Biology Committee were the first in Europe to apply to purposes of Biological investigation), and the progress made in publishing the volumes containing the "Fauna of Liverpool Bay." The total number of species now recorded amounts to 1,456, nine of which were new to science, and twenty-one had not been previously found in British seas. In the present paper, fifty species were added, three of which are entirely new to science. Several naturalists have worked at the station on Puffin Island for long or short periods during the summer. The Committee have exchanged their small steam launch for a 9-ton cutter, more suited to their requirements. The Curator, Mr. A. Rutherford, keeps a useful weekly record of the sea and air temperatures, and other physical observations. From these tables it is now possible to trace the distribution throughout the year, and the relations to temperature of the algæ, the appearance of which in such profusion as to cause "foul water" was recorded by different observers on the coast in 1885 and following years. In this neighbourhood it was found that the "foul water" was due to the presence of small gelatinous spherical bodies, containing minute spicules. When these minute algæ are present in quantity the "tow-net" is almost useless, as the other organisms in the water become so entangled with the masses of diatoms that it is difficult to separate them. Dr. Herdman has also commenced detailed observations upon the zones of life on the shore, and has arranged for the measurement of the exact distances of certain species of animals and plants vertically from high and low water, and for placing permanent marks upon the shore at each end of the island, so as to facilitate the taking of future observations. Depth has a great effect upon the fauna and flora of a region, and it is expected that the more exact observations which will now be possible will lead to useful results. An appendix gives a first list of plants on Puffin Island. Altogether the present report speaks well for the progress of the biological work which is carried on under the guiding hand of Dr. Herdman.

Letter to the Editor.

THE LUMINOSITY OF PLANTS.

Sir,—Since the publication of my article on the above subject I have been favoured with a copy of the printed address on Luminosity, read to the members of the Liverpool Naturalists' Field Club in January, 1889, by their president, the Rev. H. H. Higgins. From the entertaining account of the phenomenon given by this experienced naturalist I extract the following particulars, which, being based upon the personal experience of the writer, I hope may be found an interesting appendix to my article.

The writer thus describes his first acquaintance with the phenomenon:—On a certain damp, murky night "a pale-green light, soft and steady, shone in patches on either side of the way. The luminosity was abundant though not brilliant, and was probably displayed by some Conferva or other Alga, induced by exceptional conditions to give out a copious and beautiful light." I presume that Mr. Higgins has good reason for ascribing the property to Algæ, for he does so twice. There is, of course, no known reason why Algæ should not emit light, but this is the first recorded instance of their doing so which I have met with.

As regards the luminosity of Fungi, the writer tells of two poplars, the rotting stems of which had at one part become mere touchwood, of which "handfuls could be taken out, but every fleck was luminous, having a pale but pleasant light."

I am glad that Mr. Higgins' experiences include a very positive acquaintance with luminosity among flowering plants, for it is certainly very unsatisfactory to assign all the instances given by past observers to mere optical illusion. He thus describes his acquaintance with the phenomenon as beheld for many summers during the opening of the flowers of the large-flowered evening primrose: "A luminous glow seemed to fill the cup of the flower, and to extend, like an electric aura, to other parts of the inflorescence. I saw no flashes, but only, within the flower, a delicate, pseudo-tremulous, seething, or quivering motion."

As to the fact that the emission of light by flowering plants has not been observed by many botanists, the writer favours the following explanation:—The light might be of such "extreme tenuity" as to be perceptible to only the more sensitive parts of the retina, which could be reached only by rays falling obliquely. Hence the light would be seldom seen, and generally then, as stated by observers, in flashes. There is force, too, in Mr. Higgins' suggestion that the phenomenon "requires observers peculiarly sensitive." It is said that the cry of the bat cannot be distinguished by some people, who can hear very well in other respects. But evolution of light by flowers must occur rarely and only at peculiar intervals; for, in spite of the necessity for obliquity and for a specially-sensitive eye, the phenomenon would not be so lacking in corroboration if it were of frequent occurrence. In connection with this it may be noted that the time at which Mr. Higgins observed the light, viz., at "the opening of the flowers," tends to support the conclusion, so well maintained by Fabre, that luminosity is closely connected with respiration, for it is when plants are flowering that respiration is exceptionally vigorous.

Theodore W. Dicker.

Publications Received.

A Catalogue of British Fossil Vertebrates, by Arthur Smith Woodward, F.G.S., and Charles Davies Sherborn, F.G.S. (Dulau & Co.); *Elements of Laboratory Work*, by A. G. Earl, M.A., F.C.S. (Longmans, Green & Co.); *Field Club*, January. The following publications for February:—*Asiatic, Naturalist, Life Lore, Arts Monthly, Knowledge*, and *Brewers' Journal*.

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NOTICES.

Several important Articles on "Minerals at the Paris Exhibition;" "Popular Lunar Superstitions;" "Ships: Their Preservation from Fouling;" "Bees and Flowers;" &c. are in type, and will appear in our next issue.

"RESEARCH" is published on the 1st day of each month, and may be obtained at the Railway Book-stalls, and from all Booksellers and Newsagents, from the Publisher, 32, Castle St., Liverpool; from the London Publisher, Mr. E W. ALLEN, 4, Ave Maria Lane, E.C.; or in Edinburgh and Glasgow, from Messrs. JOHN MENZIES & CO. Price 3d., or by post, 4d. Annual Subscription 3s., or by post, 4s.

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Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Coal in Cheshire.

THE past month has witnessed a remarkable activity in the development of our coal resources. By the discovery of coal at a workable depth underneath the Cretaceous and Oolitic rocks of the county of Kent, not only is an important geological question set at rest, but an unknown, and in all probability, a satisfactory quantity is added to the available supplies of this much-needed mineral in Great Britain.

If we can place any reliance upon the estimates which have been given by competent mining authorities as to the rate of exhaustion of our coal-fields, it is evident that the time is now approaching when we must face the problem of seeking coal in districts other than those where visible coal-measures occur at, or near the surface. It will be necessary, in order to replenish our supplies, to seek for new and productive fields by penetrating below the overlying crust of post-carboniferous rocks, under which lie hidden, at problematical depths, quantities of coal exceeding, for aught we know, in the aggregate, those of any existing coal-measures now being worked. The success of the Kentish borings will probably induce other attempts in various parts of the country.

Already the enterprising Board of Directors of the Salt Union, Limited, have determined to put the question to the test so far as regards their own property in Cheshire. Speaking at the annual meeting of this company, the chairman (Lord THURLOW) stated that the Directors had decided on boring in Cheshire to see whether they could not find coal under their salt-beds, and he proceeded:

"From the opinions they had received from most competent men, there could be little doubt they were on the eve of a discovery greater than that of coal in Kent, and which would, perhaps, double and treble the value of their property. They intended to bore 4,000 feet, if necessary."

It would be interesting to learn the facts upon which were based the opinions given by the competent authorities to whom the chairman alluded in terms somewhat vague, even allowing for the rhetorical necessities of a shareholders' meeting. No deep borings extending below the Red Marl have been made in the vicinity of Northwich, and although it has long been assumed that Carboniferous rocks exist underneath the immense thickness of the Trias in the Cheshire basin, yet, nothing has been discovered to prove the existence of coal-measures at a depth ordinarily considered workable.

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While it is on this account all the more desirable that the question—whether as a scientific problem, or as a commercial undertaking—should be definitely settled by actual borings, it is well that the persons who are interested should have an opportunity of carefully considering the matter in its various aspects.

The Red Marl, upon which Northwich stands, is usually estimated at from 1,000 to 1,500 feet in thickness, and it may be more. We have no reason to doubt that it is followed by the other beds of Keuper and Bunter, in their usual succession, for which a thickness of about 2,200 feet may be reckoned. Underneath these beds, there is, too, in all probability, an unknown thickness of Permian and Carboniferous strata to be passed through before reaching productive coal-measures, so that it would seem that the estimate of 4,000 feet given by the chairman of the Salt Union is by no means an exaggerated one.

In Professor Hull's *Coal Fields of Great Britain* (edition of 1881), the author endorses the opinion that coal exists under the plain of Cheshire, but adds "in order to reach the highest workable seam under Northwich, it would be necessary to carry the shaft which reaches the great bed of rock-salt at least 4,000 feet deeper than at present." In another part of the same work, after giving reasons for believing that the temperature at a depth of 3,000 feet would be 98°, he considers that in face of the obstacles of temperature and pressure, it is Utopian to include as workable those coal supplies existing below a depth of 4,000 feet. This depth was the limit accepted by the Royal Coal Commission.

Of late years, however, coal has been worked in many Lancashire collieries at depths greater than was formerly considered possible, and at a recent meeting of the Manchester Geological Society several instances were given of collieries where workings are actually conducted at depths of 3,000 feet and over, and where the temperature in working places is from 85° to 90°. The question, therefore, of the practicability of the getting of coal at great depths is largely dependent upon engineering difficulties and upon considerations of increased cost of working and haulage.

If coal under Cheshire is found at a less depth than 4,000 feet there is every probability of the enterprise being successful. In any case the proposed boring at Northwich will have a definite scientific value, and its progress will be regarded with the greatest interest by geologists.

Discovery of Coal at Dover.

The boring at the Shakspere Cliff, Dover, which has been in progress for four years, has now resulted in an important discovery of coal, at a depth of 1180 feet from the surface. A second seam of coal, eight feet in thickness is reported to have been reached. This discovery solves the vexed question which has been agitating geologists for over 30 years, and confirms the truth of the opinions uttered so long ago as 1855 by Mr. Godwin-Austen, as to the existence of productive Coal Measures beneath the Oolitic and Cretaceous rocks of the south of England. The following is a generalized section of the strata passed through in the boring :—

	Feet.
Cretaceous, including Chalk, Gault, and Neocomian ...	500
Oolitic, including Portland Strata, Kimmeridge Clay, Coralline Rocks, and Oxford Clay, &c.	600
Coal Measures, Sandstones and Shales, with seams of Coal	20

The Preservation of Birds.

Now that the summer season is approaching, it may be of interest to learn that a petition has been drawn up by the Rev. F. O. Morris, for presentation to Parliament, restricting the taking of the nests or eggs of any wild bird to those holding a temporary licence, without which, the seizure of eggs or nests shall be punishable under a proposed supplementary enactment to the Wild Birds Protection Act, of 1880. The object of this is stated to be the more effectual protection of insectivorous birds in the interests of agriculture.

Hailstones: A New Theory.

By Daniel Clague, F.G.S.

The fall of hailstones is by no means an uncommon phenomenon in this country; but, like many other common things, is often unstudied. This was so in my case until last June, when we were visited by a thunderstorm of some severity, which was accompanied by a fall of hail of remarkable size and shape. From that day my attention was drawn to the subject. Referring to records of previous hailstorms, we find that there have been some remarkable storms in the past.

Dr. R. James Mann describes one which broke over Richmond and Kew in August, 1874. He says :—

"Distant lightning was observed playing incessantly about the horizon from nine o'clock in the evening, and about two in the morning the storm burst over Richmond in the midst of a violent squall of wind, accompanied by flashing lightning and rolling thunder.

"Hail fell during about ten minutes. Many of the hailstones were so large that they could not be put into drinking glasses of an ordinary size. Individual specimens weighed a quarter of a pound. All the glass which had a northern and a north-eastern exposure in the tract of this storm was broken."

"The area of the storm was about fourteen square miles, and inflicted a loss in broken glass alone which was estimated at £30,000.—*Science for All*, Vol III., pp 293-294."

Commander Porter graphically describes his experience in the language of the nineteenth century.

"Immediately we heard a sound like rumbling thunder, or ten thousand carriages rolling furiously over the pavement. The whole Bosphorus was in a foam as though heaven's artillery had been discharged upon us and our frail machine. Our fate seemed inevitable: our umbrellas were raised to protect us, the lumps of ice stripped them into ribbons. We fortunately had a bullock's hide in the boat under which we crawled and saved ourselves from further injury. One man of the three oarsmen had his head literally smashed, another was much injured in the shoulder. Balls of ice as large as my two fists fell into the boat, some of them came with such violence as certainly to have broken an arm or a leg had they struck us in those parts, the scene lasted perhaps five minutes, but it was five minutes of the most awful feeling that I ever experienced."—*Bastow*, "Hail," p. 313.

In connection with these hailstones, there are a few facts that call for special notice :—

1. The stones fell not during cold but hot weather.
2. The storm burst accompanied with thunder and lightning.
3. The stones were abnormally large.

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4. And I may add that, although I have not in the previous brief notices referred to the fact, where noticed at all, the shape and structure of the hailstones were equally remarkable.

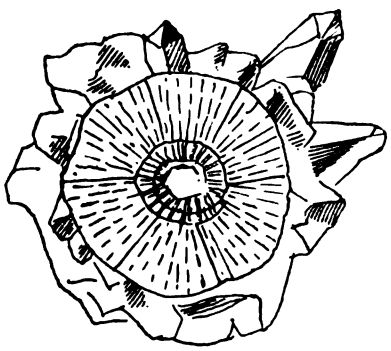
During cold weather it is not an unusual occurrence for the drops of rain to freeze in falling and come down frozen rain drops, having a pear-like shape, the thick, rounded end of the drop falling first, the smaller end following after.

In some cases numbers of these stones clash against each other in their descent and get broken into pieces, and these, on coming again into contact with each other, re-freeze together, forming those irregular lumps of ice which we sometimes see of larger size than usual.

It must not be forgotten, however, that, in freezing, the water not only assumes a solid condition, but also a crystalline structure, and in many cases a distinctly crystallised form.

This is clear in the case of snowflakes, which are really crystallised dew—water vapour crystallising in the act of condensing, and passing almost directly into the solid state without any delay in the liquid condition. It will be seen from the figures of snow crystals—such as are given in Tyndall's *Forms of Water*—that, while the forms are beautiful in their wonderful variety, they are also beautiful in their equally wonderful regularity and symmetry of form, being made up of six-limbed or six-sided forms in all the variety which such a complex system of crystallization allows.

Now, when we turn to hailstones, which are also composed of water frozen under other conditions, we may expect to find an analogous condition of things.



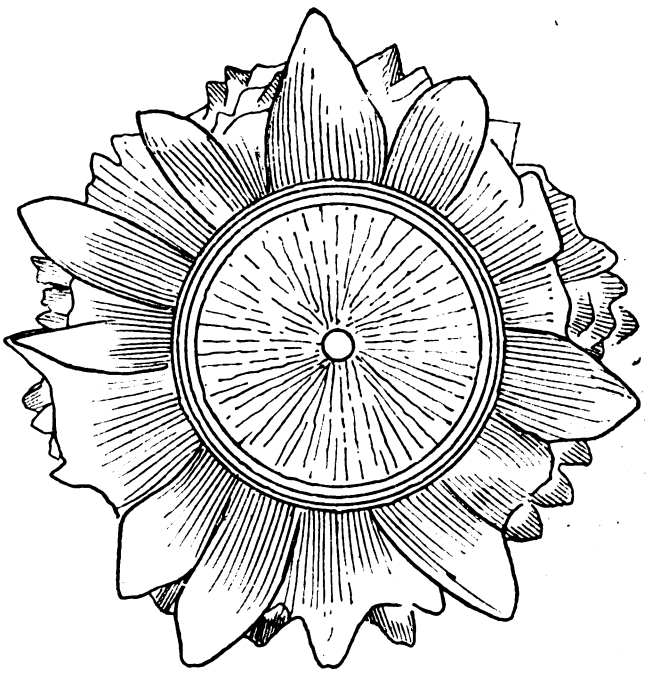
Section of Hailstone that fell in Georgia, 9th June, 1869.

The sketches represent two hailstones in section : one, which fell in Georgia in 1869—examined, figured, and described by H. Abich—shows a stellate structure of crystalline rays, extending from a central nucleus to the circumference, and the whole divided into six compartments by more distinctly-marked planes. The other was examined in France by Capt. Delcross in 1819. In this we have the same fibrous structure radiating from the centre, but not so distinctly marked into six sets or chambers as in the previous one, nor are the projecting crystal points so symmetrical as one would have expected.

The crystal terminations on Abich's hailstone are a little confusing, as the forms shewn are not in accordance with the forms taken by ice crystals. I can only suppose that the sketch was made by a careful observer who noticed the crystal facets on the exterior of the stone, but ignorant of the principles of Crystallography, had sketched at random, supposing one form as correct as another.

The radiate structure was observed in hailstones which fell in Liverpool last June by Mr. Brown, who broke open many of the hailstones, and remarked upon the resemblance to the section of a tree which they presented, having a number of concentric lines representing the stages of growth, and the radiating lines resembling the medullary rays of timber. Some remarkable stones which fell during the hailstorm of June last are figured and described in *Research*, Vol. ii., p 16.

When gathered, they were melted to such an extent that it was impossible to say whether these spines were also hexagonal. In some, as one would expect, there were indications in a coarse ribbing or fleeting lengthwise that such had been the case.



Section of Hailstone that fell in France, 4th July, 1819.

More recently the case has been settled by the observations of Prof. Edwin J. Houston, of Philadelphia, who describes a hailstorm which prevailed there on Oct. 1st last (1889) :—"On some of them," he says, "though not on the majority, well marked crystals of clear transparent ice projected from their outer surfaces for distances ranging from $\frac{1}{8}$ to $\frac{1}{4}$ inch ; the crystals, as well as I could observe from the evanescent nature of the material, were hexagonal prisms, with clearly cut terminal facets."—*Nature*, vol. 41, page 43.

The size of the stones calls for notice. Those figured in *Research* were—Body, $1\frac{1}{2}$-inch with protuberances of an equal length.

One picked up at Toddington in 1874 was bell-shaped, nearly $4\frac{1}{2}$ inches long.

In 1829 stones fell at Cazorta, in Spain, which weighed nearly $4\frac{1}{2}$ lbs.

In Hungary, in 1852, stones fell which measured 39 inches in 2 diameters, and 28 inches thick. These, however, could not have been regular hailstones with the crystalline structure of which I have spoken, but numbers of hailstones frozen together.

Those which fell at Georgia, near the Caucassus, were, however, 3 inches across, and weighed 4 ounces, which may perhaps be taken as a typical size.

These large stones fell not in cold weather, when there was not a likelihood of the rain drops freezing as they approached the earth, but in hot weather when the tendency was entirely in the opposite extreme. Small stones of frozen rain we may and do have in winter, and in cold countries, but the typical hailstones are formed and fall in warm countries and in hot weather, and are usually, if not universally, accompanied with violent thunderstorms.

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Now, whatever may be the cause of the congealing of the atmospheric vapour, one thing is clear that the freezing, and consequently crystallization, must have taken place quickly—yes, instantaneously, for their weight precludes the possibility of their having been suspended in the atmosphere for any time.

The formation of these hailstones has been attributed to the electrical discharges which accompany the fall; and M. Defour, of Lausanne, has proved by experiment that crystalline ice can be formed by electrical discharges; and, whilst I am prepared to admit that, I find that it does not touch the real difficulty. M. Defour succeeded in forming small lumps of crystalline ice by electricity, but we want to explain not the origin of small, but of large lumps, and that instantaneously.

All who are familiar with the process of crystallization will know that the crystals formed rapidly are usually very small, whilst those whose growth is long continued reach a greater size.

An experiment performed by a number of students who sat round the table, with a microscope and a number of slips of glass before each, is to the point.

Bicromate of potash was dissolved in hot water and a drop of the solution placed on a slip of glass for each student who examined it carefully through the microscope, when, to the interested gaze of each, some of nature's secret ways of working were revealed; tiny dots of solid matter sprung into existence before our eyes, and rushing hither and thither sought and found their proper places in the figures that were formed during the cooling of the solution. On comparing notes, some had on their slides beautiful little crystals of yellowish-red bicromate of potash, others had their glass slips covered with still more beautiful figures of trees, mosses, &c.; in the same substance clearly then there were two laws at work, one of which we had, the other we had not discovered.

To discover the second law was our next aim. I need not tell of repeated experiments and failures, but at length we succeeded.

Some of the clear glass slides were laid before the fire to warm, and some placed out of doors to cool.

In due time a drop of solution was placed on the hot slide, and under the microscope the movements of the solid dots were again seen in progress. That soon stopped; the hot slide caused the water to evaporate quickly, and our slides showed the arborescent forms, which had so charmed us before.

Next, a drop of the solution was placed on each of the cold slides, and the motion of solid dots again was observed, but the moisture was not so soon evaporated, and they had a little longer time to do their work and get to their places—only a few seconds more—but it was enough. Now we saw the crystals formed, and in some cases straggling globulites fringed the edge of the crystals with moss-like aggregations, showing that, had more time been allowed them, they too would have taken their places in the mass, and the crystal would have been so much larger.

The secret then was revealed. Small crystals are formed rapidly, the larger crystals require more time—so thoroughly is this law understood, that in studying crystalline rocks we instinctively decide that the fine close-grained stones in which no crystals are visible have cooled quickly near the surface, or perhaps at the surface, having been ejected from a volcano in a molten condition—whilst those which are coarse-grained and contain large crystals represent deep-seated rocks, perhaps even those of the very subterranean caverns in which molten matter which was ejected from the volcano had been fused, and had taken ages, the duration of which our chronology cannot reckon, in which to cool.

Now, to return to our hailstones. The problem we have before us is this: Here we have large crystals formed instantaneously. What are the conditions which has led nature to suspend her ordinary rules? Or to keep up the figure used before—having found out two of nature's laws—we see a third hidden one which we wish to discover.

M. Defour's experiment on the subject is not to the point, for he succeeded only in forming small crystals. Perhaps if he had sent a series of shocks or a long-continued current through his preparation, he would have succeeded in forming large crystals; he had to suspend his moisture on a surface of mercury to give him time to electrify into existence even small hailstones. Now, since Nature does not have a basin of mercury to keep up the material on which she works, and the forces of gravitation are ever working, it is clear that the rapid descent of such solid bodies would preclude the idea of such an agency having been at any rate the sole cause of our phenomena.

We must look further. There is a law in nature often forgotten that may help us. We are accustomed to call a given degree of cold *freezing point*. It is that point at which, under the conditions of thermometer making, water freezes or ice melts, and is marked 32° on Farenheit's scale.

The forgotten law is that under certain conditions water may be reduced to a lower degree of temperature without becoming solid. The conditions are:—

1. No sharp points, or any foreign matter, must be in the water, *i.e.*, it must be in a perfectly smooth vessel.

2. It must be perfectly still.

Under such conditions the temperature may be reduced to 30°, 29°, or even 28° F. before the water will solidify, but if the vessel be shaken, or a spoon or stick be placed in the liquid, or some sand grain thrown into it, it will be instantly converted into a solid mass of ice.

Now I think this will perhaps help us in our investigation. Given a mass of water, taken up into the atmosphere in a gaseous form, it rises higher and higher till meeting with air so cold that it condenses into watery vapour in the higher regions of the atmosphere, and appears as clouds, where it is subject to cold influences, and becomes colder and colder till it is at a point at which on earth it would freeze, but here no sharp angles, or protuberances, nor any disturbing influences at work, the temperature still sinking below freezing point, its gravity is increased; it sinks, but very gradually and gently, as clouds and mists always do.

We have on earth a condition of sultry heat which causes an uprush of hot air. On such occasions we have little whirlwinds—made manifest by the fine dust they raise and twirl round. The hot air still rises and, tongue-like, penetrates with its circular motion the mass of vapour, the temperature of which is below that called freezing point. The so-called conditions of *instant solidification*, are now present, and the forging and shooting of the immense ice bolts we have been studying takes place simultaneously.

Such is the simple explanation of the formation of large hailstones which I have to offer.

Is there any confirmative evidence that such foreign matter gets into the clouds? I think there is. On that 2nd of June which I have alluded to, on my return home after the storm, I found the study windows had been left open, and several hailstones lay melting upon a black board which was on the floor, forming a covering for some plants which were being pressed for preservation. When melted and evaporated, a white, powdery patch marked on the black board the place where each hailstone had melted. I had not an opportunity of examining this matter, but a noted Liverpool microscopist had secured a few hailstones, and subjected them to microscopic examination, and announced to the public a few days subsequently the fact that the hailstones had contained vegetable spores.

During a subsequent fall of hailstones on Monday, 18th Nov., 1889, I secured half-a-dozen good clean hailstones which I placed at once on slips of glass and put by carefully out of the dust until the ice had melted and the water had evaporated, then covered

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them with thin glass covers so as to preserve for future study; an accident occurred to one, but I had still five slides which shewed that foreign matters existed in each of the hailstones, and to some extent was able to read the character of that foreign matter. These specks of dust which require a power of 250 diameter at least to read them, appear to be some little vegetable seed bladders, or asci, which had burst from some ripening fungi (parasitic probably), some of which were complete, shewing their contents within; some burst open and the sporidia spread abroad.

Others appear to be more complex in structure; one resembles the outspread petals of a flower of the cruciferæ order, but probably it is only the seed case of some more lowly plant.

The examination of these slides is not complete, but enough has been done to shew that in the formation of hailstones we have an illustration of that third law I referred to, that water may be reduced to a temperature much below ordinary freezing point without freezing, under given conditions; but a violation of those conditions either by the motion of an uprush of hot air or the intrusion of minute particles of dust, too small to be seen singly by the human eye, is enough to make the whole mass rapidly congeal, and even then, though rapid almost as a lightning flash, the law of crystallization still operates; each particle knows its own place and takes it in the most orderly manner.

Fossils and Evolution.

By Dr. McPherson, F.R.S.E.

VERY naturally those who are studying the theory of evolution in the floræ and faunæ now existing will endeavour to trace some foundation for the fascinating magic-wand in the fossils which are found in the strata that have been successively deposited in the earth's formation. Palæontology is, therefore, more than ordinary interesting. It is the science which treats of the living beings, whether animal or vegetable, which have inhabited the earth at vast periods in its history. It is the ancient life-history of the earth; and if its record could ever be completed, it would furnish us with an account of the structure, habits, and distribution of all the animals and plants which have at any time flourished upon the land-surface of the globe or inhabited its waters. The study of fossil animals and plants is based upon the knowledge of living animals and plants. Strictly speaking, according to Lyell, the term "fossil" means any body, or the traces of the existence of any body, whether animal or vegetable, which has been buried in the earth by natural causes. Besides this, there are moulds or casts of shells, and the footprints or markings left by various animals upon sand and mud.

It is not yet very long ago since naturalists believed that the existing form of animals and plants had been simultaneously produced by a special act of creation, and that they had not been produced by pre-existent animals and plants. Fossils were believed to have been simply produced as they are at once by an act of creation. In fact, we were once ashamed to hear an intelligent minister, in the course of his sermon, state that these phenomena were placed there (he did not say by whom, angel or devil) to tempt man to scepticism.

Now we are glad to say intelligent people are of opinion that our existing animals and plants have been preceded by many antecedent faunæ and floræ; and that the existing animals and plants are the modified descendants of older forms of life. Of course, the actual *beginnings* of life upon the earth are still unknown to naturalists. And we have no reason to believe that the most ancient of known fossils belong to animals which first came to existence. Palæontology teaches us that new forms of life have been from time to time introduced upon the earth, and that forms already in existence have become extinct. But it is quite certain that there has been not only a succession but likewise a progression of organic forms in proceeding from the most ancient of geological periods to the present day. In fact, the whole subject of the evolution of life-forms in time involves some of the most profound and fascinating problems.

Professor Alleyne Nicholson, of Aberdeen, has lately published a most admirable work on the whole subject, illustrated with fourteen hundred diagrams. In it he confesses that we are likely to know nothing of the animals and plants which really constituted the first living beings. From the Cambrian period onwards new species have been introduced, apparently almost continuously. And when we meet with the apparently sudden incoming of a large number of new life-forms, we may take it for granted that we have to deal with a *hiatus* in the geological record in the particular area in which the phenomenon is observed. The new forms have been in existence elsewhere, and what we are observing is not the first introduction upon the earth, but merely their first introduction into the area in question.

As a general rule it is the animals which have the lowest and simplest organisation that have the longest range in time; and the additional possession of microscopic dimensions seems also to favour longevity. But what of the extinction of species? It may be taken for granted that the sudden disappearance of a whole group of morphological types is more apparent than real. But why some groups should show such an extraordinary power of rapid extension and of the development of new types when first introduced upon the earth, and should therefore progressively decay and ultimately become extinct, is a problem not yet solved. We must, however, remember, that in many cases "extinction" implies nothing more than continued existence under a new form.

Upon any theory of evolution, it must be held that there was no sudden destruction of life at the close of each great geological epoch, and no creation of fresh forms at the commencement of the next period. On the contrary, it is established that there is a geological "continuity," such as we see in other departments of nature. It is certain that there can be no total break in the great series of the stratified deposits, but that there must have been a complete continuity of life, and a more or less complete continuity of deposition from the Cambrian period to the present day. According to Professor Lapworth, however, it has been shown that the fossils of a given formation may be divided into groups. He has recognised in the Silurian and Ordovician rocks numerous well-marked "life-zones," characterised for the most part by particular types of fossils. These life-zones must have been deposited with extreme slowness.

Palæontology has furnished a mass of evidence in favour of the view that the introduction of new species in past time has been by evolution from pre-existing forms. Some general laws of evolution have been at work whereby the later forms of life have been derived from the older ones. For the primary morphological types which we see among existing animals are identical with the types upon which fossil animals are constructed. While the great majority of fossils are extinct, and while many of them are extremely unlike any existing forms, no fossil animal has hitherto been detected which cannot be referred to one or other of the existing sub-kingdoms. Besides, the investigation of fossil animals has tended to greatly diminish the intervals by which allied groups of existing animals are separated. Many fossil animals exhibit what are termed "generalised" characters. If, namely, we construct a general or ideal type for any great group of animals—a type which shall possess all the essential characters of the group, without its non-essential ones—then it is found that the fossil animals of the same group are generally nearer to this type than are its living representatives.

This is an important conclusion. The older representatives of any given group of fossil animals are usually nearer to the ideal type of the group—or are more generalised—than are the later representatives of the same group. There is, zoologists know, a gradual and unmistakeable progress from the general to the special, the embryo being nearer to the general type of the group to which it belongs than the adult; *i.e.*, the

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embryo animal is more generalised than the adult. The fossil forms which belong to the oldest strata are more embryonic, and are more generalised. The living representatives are more specialised

Again, overwhelming evidence in favour of a general theory of evolution is afforded by the similarity of the types of life in successive faunæ and floræ. The animals and plants of each geological system are more closely related to the animals and plants of the system immediately below and to those of the system immediately above, than they are to the organisms of any other rock group in the stratified series. This fact shows that the organisms of each period are the modified descendants of those of the preceding period. There is a distinct upward progress from the lower to the higher, or from the more generalised to the more specialised. There has been a progression in the order of their development, the lower types having, in the main, preceded the higher in time.

Still, though the general history of fossils gives overwhelming evidence in favour of the view that some general law of evolution has been at work in the production of the varied forms of life which now exist or have existed in the past, Professor Nicholson is strongly of opinion that there is no *direct* palæontological evidence which would certainly establish any particular theory as to the precise *modus operandi* of this law. He says: "With regard to the theory of the origin of species by means of natural selection, which the world owes to the genius of Darwin, the evidence of Palæontology cannot be said to be conclusive."

It is an essential part of the theory of natural selection that the production of any given species from any pre-existing species can only have been effected through the intervention of a long series of intermediate or transitional forms. Now, though it is true that extinct animals are known which are transitional between separated groups now in existence, still, as a general rule, these transitional forms are few in number, and are so far isolated as to be in themselves distinct morphological types. The learned Professor is, therefore, of opinion that the life-history of the earth in fossils has, to a large extent, failed to bring forward the numerous and closely *graduated* series of intermediate forms which must at one time have existed, if natural selection was the sole agent in the organisation of the new species. At the same time, the marvellous theory of the origin of species, as detailed with painstaking minuteness by the colossal mind of Darwin, constitutes an invaluable and indispensable guide in all branches of palæontological research. This is a glorious field for careful workers, and much depends upon their labours. *Research* cannot be more interestingly employed in this test age of accounting for all the phenomena of nature.

Museum Notes.

A BILL has been introduced into the House of Commons by Sir John Lubbock, Mr. Baumann, Mr. Sydney Buxton, Sir William Houldsworth, and Mr. Justin M'Carthy to amend the Public Libraries Act. It substitutes the county and borough electorate as established by the County Electors Act, 1888, and the Municipal Corporations Act, 1882, for the electorate of ratepayers to whom the power of adopting the Libraries Act is given by the Act of 1855. Where the district in which it is proposed to apply the Act contains a population of more than 5,000 it provides that the opinion of the voters shall be taken by voting papers alone; and that the acts may be adopted subject to a condition that the maximum rate shall not exceed ½d. or ¼d. in the £, and that these limitations may be wholly removed, or that the ½d. limitation may be extended to ¼d. By the regulations embodied in the Bill, it is proposed that a majority of those voting shall prevail, and not that a majority of the constituency shall be necessary; and that each voter may vote separately on each question of the adoption of the Acts, and as to the rate to be fixed, there being a separate scrutiny to each question.

FROM the commencement of its history, the Liverpool Free Public Museum has been open to the public on four days in the week. This arrangement has now been altered, and the museum is opened every week-day except Friday.

THE following addresses have been delivered during the past month at the Liverpool Free Public Museum:—"Animals and Their Uses," by Mr. R. Paden; "Wedgewood," by Miss E. M. Wood; "Egyptian Gods and Mummies," by Mr. P. Entwistle (Curator Mayer Museum); "Organs, Old and New," by Mr. W. J. Argent.

THE Liverpool Library Committee's report for the year ending 31st December, 1889, opens with "A Tribute" to the memory of the late Chairman, Sir James A. Picton, F.S.A. The report states that visits of scientists interested in museums have been numerous and included, Dr. A. R. Wallace, Professor A. Newton, Dr. Leidy, of Philadelphia, and several American professors on their way to the Paris Exhibition. The circulating school museum cabinets have been in request and lead to more frequent visits to the museum from scholars.

THE restoration has been commenced of the University of Toronto, which a fire destroyed on the 14th of February. The magnificent library, the priceless collections of the museums, a great part of the scientific apparatus, the contents of the students' armoury, were all destroyed. The work of the University was not interfered with.

DR. DAVID SHARP, the well-known entomologist, and late president of the Entomological Society of London, has accepted the appointment of Curator in Zoology in the museum of the University of Cambridge, vacated by the resignation of the Rev. A. H. Cooke, whose labours on the Macandrew collection in that museum have been highly appreciated by conchologists.

THE memorial to the trustees of the British Museum on the subject of the delivery of letters and telegrams to readers using the rooms has speedily been dealt with. The memorial proposed that all telegrams and letters should be delivered to those who undertook in writing not to address their letters from the British Museum, and who also promised to discourage correspondents from writing to them there. It was signed by some sixty readers, the chief part of whom were authors, journalists, and scholars, and it was presented to the trustees by Mr. E. Maunde Thompson, the principal librarian. It was agreed to allow the delivery of telegrams and foreign letters to the readers, but the privilege was not extended to English letters.

THE report of the committee of the Liverpool Free Public Library, Museum, and Walker Art Gallery, for the year 1889, has been issued. The statistics contained in the report show that in the reference library there were issued during the twelve months 444,649 volumes, exhibiting a decrease of 57,649 volumes from the number issued in the previous year. The decrease was proportionate in the several classes of literature into which the books are divided, except Latin and Greek classics, which show an increase of 485 volumes. The volumes added to the library during the year number 2,404. The books borrowed from the lending libraries also show a decrease to the extent of 42,106 volumes. Including periodicals, the total number of books issued during the year was 763,395. Many donations to the library and museum have been received, those made by the executors of the late Sir James Picton being most noteworthy. The popular lectures delivered at the Rotunda Hall during the months January to March were attended by 83,646 persons, giving an average of 921 per lecture. The valuable series of literary and scientific autumn lectures, for which admission fees were charged, was attended by 6,672 persons. The visitors to the museum numbered 282,559, as against 291,754 in 1888, the weekly average being 5,424, and the daily average 1,326. The total number of visitors to the Walker Art Gallery was 425,239, or a daily average attendance of 1,456. Included in this total are 62,942 visitors who paid for admission to the Autumn Exhibition, 10,000 pupils of schools admitted free, and 12,280 visitors on the last four Saturday evenings, when free admission to the exhibition was granted.

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An incident lately occurred at the British Museum which emphasises the need we have pointed out for guides in museums. A labouring man was standing in the Elgin Room, and, touching his hat, asked a gentleman if he could tell him what the marbles meant. Thereupon, the gentleman addressed gave a brief account of their history, and before long the audience of one had increased to over twenty, who listened with intense interest, and begged him to continue after he had finished his extempore little oration.

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In the *Liverpool Review*, for March 8th, appears an interesting personal narrative under the head of "Reminiscences," by Mr. J. T. Moore, Cor. Mem. Z.S., Curator of the Derby Museum at Liverpool. In the Editor's introduction, Mr. Moore is described as "a rather short, elderly gentleman, with grey hair and beard, who bears a close resemblance to the late Charles Beard." The autobiographical sketch is as characteristically modest as is the author.

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Men of science who have visited Newcastle have been astonished at what they have seen in the museum at Barras Bridge. The treasures arranged therein may be said to be unequalled in any part of the country. It is mainly to Mr. John Hancock that the town is indebted for this extensive and exquisite collection. It has been suggested that the museum at Barras Bridge should receive a more distinctive name than that which it now bears, and the name of Mr. Hancock naturally occurs in this connection.

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The Museum, Libraries, and Parks Committee of the County Borough of Salford have issued their forty-first annual report. Some valuable additions have been made to the marble sculpture in the Langworthy Gallery. An exhibition of present-day photographs, held in the museum last summer, was very successful, being visited by about one hundred thousand persons during the three months it remained open. During the winter, six free public lectures were held in the reading-room, and in October, an exhibition of Gas Stoves and Gas Appliances was opened in a building in Peel Park. The Libraries and Reading-Rooms are open on Sundays, the total attendances on that day at the four libraries (Peel Park, Greengate, Regent Road, and Pendleton) from the opening, September, 1888, to October, 1889, being 53,459, or an average of 876 for each Sunday.

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In connection with the series of Saturday afternoon lectures in the museum of Owens College, Professor Boyd Dawkins, commenced a course of three lectures on the subject, "The place of man in the geological record." Aided by excellent diagrams he described the mammalian and floral characteristics of the eocene, the miocene, and the pliocene ages of the earth. He said they could not look with any success for the presence of man in eocene times. The conditions of life were wholly unlike what they are now, and the animals which were living on the earth then were wholly different from those of to-day. It was utterly contrary to the laws of evolution that they should expect to find man in the eocene epoch. If he had been living on the earth in those times, why should he have been absolved from that law of change which had overtaken all the rest of the higher mammalia? It was altogether a mistake to look for man in that age, and he emphasised that statement because certain ingenious speculations had been advanced regarding some discoveries in America. Notwithstanding some other discoveries in France, the particulars of which he had personally investigated on the spot, he also maintained that in the miocene, the succeeding age, there was not a shadow of proof anywhere in Europe of the existence of man in that period. It had been alleged that some of the highly organised apes of the miocene age were more anthropoid than the apes of to-day, that in fact they were missing links. He, however, could not accept the evidence in the least degree. The evidence was not substantiated by the geological record, and he left the subject to the speculations of those who had greater freedom of imagination than a geologist could have. He could not find any evidence to show that man existed in the pliocene age, but the surroundings of that period were such that he did not see why man should not have been living at that time. That fact, however, ought to render them all the more careful in accepting any statement which was brought forward in support of that view.

The recent completion of the Gallery of Botany at the Natural History Museum at South Kensington emphasises in a marked manner the new departure which has been taken in recent years in the study of botany. This department of that splendid, interesting, and instructive building in Cromwell Road has been the last to reach completion, but the delay has not been occasioned by neglect or indifference. The principle followed in arranging the cases is that they shall contain only type examples, the bulk of the collection being reserved in drawers or special rooms, and the difficulty with the curators has been the solution of the problem of what ought to be shown as type examples. Botanical science has undergone a very distinct change, and in displaying a collection made over many years by botanists in all parts of the world the managers of the gallery have found it necessary to recognise this change.

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Mr. Wm. White, of London, has been appointed Curator of the Ruskin Museum at Sheffield. Mr. White has not had any previous experience in museum work, but he is a devoted student of Mr. Ruskin's writings, and has also been a member of some of the local scientific societies in Essex. The museum is to be opened in Meersbrook Hall on April 15th, and the rooms are being fitted up in a very ornate and elaborate manner, the idea being, as far as possible, to have everything different from what is usual in other museums. Unfortunately, Mr. Ruskin's health has not permitted him to take any part in designing or suggesting the style of decoration and fittings, but the work has been done under the direct instructions of the trustees of St. George's Guild, and it is to be feared that in thus straining after absolute novelty in the treatment of the museum it may be accomplished at the loss of convenience for the proper exhibition of the objects in the museum. According to the rules which have just been adopted, the Ruskin Museum will be open five week-days till dusk, and on two evenings until nine o'clock, and it will also be open on Sundays, from 2 to 5 p.m.

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The Librarians of the Mersey district held their seventh quarterly meeting in the St. Helens Town Hall, on the 28th February. A paper entitled "Librarianship as an Occupation for Ladies" was read by Miss Richardson, Assistant Librarian, St. Helens Free Library. Miss Richardson's paper evinced a lively interest in her occupation and an enthusiasm which might often with advantage be emulated by librarians of the other sex. A discussion followed, in which the strong and weak points connected with the employment of females in libraries, based on experience, were fully brought out. The second item on the programme was a discussion on Messrs. Ogle and Fovargue's prize draft Consolidated and Amended Free Library Bill. This suffered somewhat from the regretted absence, through illness, of one of its authors, Mr. Ogle, of the Bootle Free Library. The sections and clauses were gone through *seriatim*, and certain amendments suggested, the greater part of this work having been undertaken by Mr. Madeley, of the Warrington Library and Museum; the honorary secretary, Mr. C. W. Sutton (Chief Librarian, Manchester), with others, taking an important part in the proceedings. Many of the clauses have an important bearing also upon museums and their management. The attendance was good, and included delegates from Manchester, Liverpool (Free Library, Athenæum, and Lyceum Libraries), Birkenhead, Bootle, Oldham, Warrington, Southport, Widnes, Runcorn, St. Helens, Manchester Medical Library, and the Mayer Library, Bebington.

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Dr. Falb's Weather Theory.

Dr. Falb's much-disputed weather theory is, as may not be generally known, founded upon the influence which the moon is supposed to have on the weather. It is, we may assume, known to everybody that the attraction of the moon causes the ebb and flow of the sea, and, according to Dr. Falb's ingenious theory, a corresponding movement must take place in the atmosphere, and just as the rise and fall of the sea varies according to the nearer or further distance of the moon to the earth, to which is also added the attraction of the sun, acting differently according to its position, the atmospheric tide wave must also be stronger at certain times than others.

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The six factors causing a higher tide than the normal are: (1) The proximity of the sun to the earth. (2) The proximity of the moon to the earth. (3) The conjunction of the sun and moon, or juxtaposition in respect of a certain meridian. (4) The conjunction of the sun and moon, or juxtaposition in respect of the Equator. (5) The sun in the Equator. (6) The moon in the Equator. It is clear that two or more of these factors may act simultaneously, thereby accentuating the effect. Factor 1 occurs once a year, at the new year; factor 2 once in every lunar month (27 days); whilst, as regards factors 3 and 4, may be mentioned that the sun accentuates the influence of the moon when new and full. The standing of the sun in the Equator occurs at the Equinoxes, *i.e.*, twice a year, whilst, correspondingly, the moon occupies a similar position twice in every lunar year.

In order further to explain the influence of the moon upon the weather Falb formulates the following theory:—The highly heated air at the Equator must rise upwards, whereby an inflow of fresh air from the sides must take place. Hereby is, as is generally known, the trade-winds caused. The air which has ascended at the Equator gradually flows towards the Poles, causing thus an Equatorial current in opposite directions to the Polar air currents at the surface of the earth. But the air in both these currents is of widely different character: the Equatorial current is moist and warm, the Polar current dry and cold. Through the action of the tide factors this circulation in the atmosphere is accelerated, the two currents come into a more active contact, and where this occurs there is a co mingling of air volumes. This co-mingling causes a cooling of the warm and moist air, creating rain, thunderstorms, and wind. These disturbances of the weather should thus be caused by the six tide factors, and should, in consequence, be more intense at the periods when they coincide. It is founded upon this coincidence that Dr. Falb bases his fixture of the dates that are most critical in respect of atmospheric and terrestrial phenomena, and divides them into three degrees, according to their intensity.

Many arguments have been advanced against this theory of Dr. Falb, some of which have recently appeared in our "Foreign Jottings," and we now add a *resumé* of another ingeniously set forth by Herr Arthur Rindell, a well-known Finnish meteorologist.

The influence of the moon upon the movements of the atmosphere, if any, should be manifested in some distinct manner as regards the weather, but in spite of many and thorough researches, meteorologists have not succeeded in demonstrating other than a hardly noticeable effect. But how can this be reconciled with the circumstance that the press so often record cases in which weather disturbances occurs on Falb's critical days. The answer is: that, partly, the unfavourable instances are not noticed, and, partly, that the predictions do not specify the parts of the globe in which the phenomenon is to occur. As regards stormy weather being due to a co-mingling of the warm Equatorial current with the cold Polar one, the most recent researches go to show that no heavy rainfall can possibly be due to such a cause. The heaviest rain storms are originated in quite a different manner from that stated by Dr. Falb. As a certain volume of air ascends, the pressure upon it lessons the more the distance from the earth is increased. The expansion consequent upon this causes, according to physical laws, a fall in the temperature, whereby the vapours in the air become condensed, and are discharged in the shape of clouds, rain, and snow.

Where an ascending movement in the air takes place, the atmospheric pressure is low, and an area within which this pressure is lower than everywhere around it is said to be situated within a barometrical minimum. These barometrical minima cause the greatest and most frequent disturbances of the weather. The barometrical minima have a varied extension, sometimes embracing an entire Continent, but generally they have a far smaller extension. In consequence of this, it often occurs that minima which cause storms and atmospheric disturbances in Northern Europe are hardly noticeable in southern latitudes, and *vice versâ*.

Thus it may happen that one of Dr. Falb's critical days will cause storms, &c., in Austria and Italy, and even further north, while we here in higher latitudes should not notice anything, and in the papers we would read of the fortunate prediction confirming the new theory, when we probably were inclined to reject it.

Such minima occur in Europe alone to the number of 90 a year, and if we allow a duration of four days to each, we shall find that not a day passes without some atmospheric disturbance occurring in some part of the Old World.

In order further to test the correctness of Dr. Falb's theory, Herr Rindell analyses the cases of the first half of last year as follows:—If we take the number of days upon which any portion of the area covered in our meteorological charts was under the influence of a minimum, even if a storm did not occur, we find that they number 121; during the same period 37 minima were in motion. And during January-June we have 3 Falb critical days of the first degree, 6 of the second, and 5 of the third. Of these 13 days 3 were entirely without any disturbance whatever, and 3 which may be said to have fulfilled half of the extent of the prediction. We have thus 8·5 cases correct out of 13, *i.e.*, 2 to 3. But of the 181 days comprising the period in question minima occurred on 121, making, therefore, also 2 to 3.

A Relic of an old Eruption.

So much attention has been given of late to the presence of floating dust in the air that some interest may be attached to a curious relic of an old volcanic eruption which lately came into my hands.

Some time ago my friend Mr. Geo. M. Hick forwarded me a small bottle for examination containing fine grey sand with black particles. A label attached to the bottle bore the following inscription:—

"Sand which fell in Barbadoes, 2nd May, 1812, and continued falling for six hours until it was half a yard deep on the ground, during which time the whole island was obscured in darkness.—Captain Gawsitte, Liverpool."

From the circumstances described it appeared probable that this sand formed part of a fall of volcanic dust, but as clouds of desert sand are not unknown to be blown over the Atlantic, it was possible that the dust might be of subaerial and not volcanic origin. Through the kindness of the Editor, an analysis was made in his Laboratory, with the following result:—

ANALYSIS OF SAND FROM BARBADOES.

Silica	58.80
Alumina	20.44
Peroxide of Iron	7.36
Lime	6.73
Magnesia	2.38
Alkalies, &c.	3.47
Combined Water	0.80
	100.00

The large quantity of alumina, iron, lime, and magnesia pointed almost conclusively to the volcanic origin of this sand, and it was with much interest that my attention was called to a graphic description in Charles Kingsley's *At Last*, of a tremendous eruption which occurred at the island of St. Vincent, a single volcanic peak in the West Indian archipelago. This occurred on April 27th, 1812, and for three days and nights the explosive force continued to hurl stones and ashes into the air, burying crops and spreading ruin from which several estates never recovered. Some idea of the enormous force exerted by this memorable outburst may be gathered from the fact that the cannonading was heard in the island of Barbadoes, eighty miles to windward of St. Vincent, and that on the last of May (to quote from Kingsley), "the clocks struck six, but the sun did not, as usual in the tropics, answer to the call. The darkness grew more intense as the morning wore on. A slow and

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silent rain of impalpable dust was falling over the whole island. I have a letter, written by one long since dead, who had at least powers of description of no common order, telling how, when he tried to go out of his house upon the east coast he could not find the trees on his own lawn, save by feeling on their stems. For the trade-wind had fallen dead; the everlasting roar of the surf was gone; and the only noise was the crashing of branches, snapped by the weight of the clammy dust. About one o'clock the veil began to lift, gradually the dust cloud drifted away, the island saw the sun once more and saw itself inches deep in black, and in this case fertilizing, dust"

An account of this eruption is also given in Scrope's *Volcanoes* (Ed. 1862, p 432), from which the following is extracted:—"St. Vincent contains an active volcano called the Morne Garon, which rises 4,940 feet above the sea. It has long been in a condition of solfatara, but occasionally breaks out into greater activity, as in 1718, and again in 1812, when its eruption followed by twenty-two days the great earthquake which overthrew the city of Caraccas on the neighbouring continent, the shocks of which were felt severely in several of the adjoining islands. During that eruption the volcano of St. Vincent threw out in a perpendicular black jet, prodigious volumes of grey ashes (pumiceous and augitic), with much organic matter (derived, probably, from a crater-lake), which nearly overspread the island."

It is evident that this dust must have been carried several miles into the air, above the region of the trade-wind. Among the samples of the dust-fall which would be preserved by the astonished residents on the island, and given to their friends, was the contents of this little bottle, a relic of a forgotten eruption, recalling, when examined after a lapse of nearly eighty years, the incident so vividly related in Kingsley's book of West Indian travel.

OSMUND W. JEFFS.

A Photographic Survey of Warwickshire.

SINCE the inauguration of the Photographic survey by the Birkenhead Amateur Photographic Society (recorded in the first number of *Research*,) the idea has spread to several other localities in England, and has been also carried out to some extent by at least one society in America—the Camera Club, of Boston. It has lately been decided to undertake a photo-survey of Warwickshire on a very extensive scale, and a scheme has been propounded by Mr. W. Jerome Harrison, F.G.S., Vice-president of the Birmingham Photographic Society, which has met with general acceptance. The details of this scheme are fully displayed in a pamphlet recently issued,* and if the energetic photographic amateurs of "Woody Warwickshire" proceed with their work upon the lines laid down by Mr. Harrison, they will have furnished a model survey which every other county in the British Islands would do well to imitate. In organising a survey of this kind, it is important, first of all, to have clearly laid down a list of the chief localities of interest, historical sites, archæological relics, geological sections, and local botanical and other scientific features to be photographed. A good county history should be taken as a guide, and local scientific memoirs should be consulted. Next, a series of ordnance maps should be procured and marked out for the various workers. Mr. Harrison suggests that each sheet of the map should be accompanied by a cardboard box, bearing the same number as the map, to contain mounted prints of all photographs taken from places or objects contained in that sheet of the map. Much of the photographic work already in existence might be utilised for the purposes of the survey.

It is not proposed to limit the size of negatives, though whole-plate (8½-in. × 6½-in.) is the size recommended. The aid of the historian, the artist, and the scientist should be enlisted in the furtherance of the work, and assistance ought to be secured from landowners and residents, and especially the guardians of the churches throughout the county. It is proposed that funds be specially raised for the purchase of maps, albums, cases, &c., and defraying the cost of printing in platinotype from the negatives taken and for making lantern slides. Whatever is done must be systematic, and as the completion of the scheme will be a work of time—if ever it can be said to be completed, for fresh material will constantly be added from year to year as the features of the towns and landscapes continually change—care should be taken at the outset to lay down such regulations as will place the practicability of the scheme on a sure footing, and to enlist in the various departments as large an array of workers as may be necessary, whether as practical photographers, or historical, topographical and scientific advisers.

The promises held out by such a survey are vast. Future generations will, if it be faithfully carried out, possess a mass of valuable material for their histories, the possession of which, in our day, would be an invaluable aid to education. Mr. Harrison was one of the earliest authors to recognise the value of photography as applied to the illustration of geological features, having published in 1878 "The Geology of Leicestershire and Rutland," illustrated by twelve photographs from whole-plates; and he has shown in many ways his interest in the work of the British Association Geological Photographs Committee. At the Conference of Photographers in 1888 he advocated the appointment of "State Photographers, who should be specially charged with the task of obtaining authentic portraits of our great men and securing pictorial records of historical places and events," so that he may be regarded as the pioneer of the photo-survey. Under his competent direction the new survey of one of the most attractive of our English counties will doubtless succeed in accomplishing some, if not all, the aims of its promoter.

* This pamphlet can be obtained, post free, from the Hon. Secretary to the Birmingham Photographic Society, A. J. Leeson, Esq., 20, Cannon St., Birmingham. Price 6d.

Coast Erosion in Yorkshire.

BY REV. E. MAULE COLE, M.A., F.G.S.

A COMMITTEE of the British Association is at work making careful enquiry into the rate of erosion of the sea coasts of England and Wales, and the influence of the artificial abstraction of shingle and other material in that action. As they truly say, the importance of this subject is universally admitted, and the urgent need for inquiry is apparent to all who have any acquaintance with the changes which are in progress upon our coast. The subject is a large one, and can only be successfully attacked by many observers, working with a common purpose, and upon some uniform plan. Hence the strong desire that the Yorkshire coast should be thoroughly examined, and the appointment of a committee in connection with the Yorkshire Naturalists' Union to carry out this work. May many careful and patient observers, whose good fortune it is to live upon the coast, at once commence investigations, and thus materially assist the committee in their important and valuable work. It is necessary that such united action should be taken for our coast, as the British Association Committee would be glad of such information at the forthcoming meeting in Leeds.

The great variety of material of which the rocks, which form the Yorkshire coast, are composed necessarily gives rise to a very jagged outline. Here, the sea has free access to the base of a perpendicular cliff, and the waves that rage horribly gather increased force from rushing over a smooth, slippery scar of lias; there, masses of fallen sandstone or chalk are heaped up in wild confusion at high-water mark, and serve as a breakwater to defy the fury of the winter storms.

Erosion, however, is always going on, although unequally, and somewhat fitfully. One cannot look at those lias and limestone scars and chalk pavement, stretching out to sea far beyond low-water mark, without realising that they are the bases of cliffs long since worn away, and that the present coast line is very different from what it was in ages that are past. If this be true of comparatively hard rocks, much more

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is it true of that softer material which fills so many pre-glacial valleys of the Yorkshire coast—namely, boulder clay. This clay is subject to a twofold denudation—sub-aerial and marine. Rain moistens it, and causes the sticky substance to be ever on the move downwards. Springs, issuing from streaks of sand, undermine it, and produce great landslips. Frost breaks off huge masses, and sends them thundering to the beach below; and then the sea licks and washes and grinds and churns till thousands of tons are converted into the finest possible mud, and carried away by the tide to form fresh land in the ages to come, and nothing is left but a few boulders, which for a time help to swell the ever-shifting beach of shingle as it travels southward.

Such being the case, we are not surprised to find that the greatest ravages on the Yorkshire coast are precisely in those localities where the cliffs are composed of boulder clay. The sea, in fact, is regaining its own, for boulder clay is an intruder—it has no business here, defiling and disfiguring all the lovely bays and arms of the sea which used to exist in the boyhood of our race, before the great Scandinavian ice giant came, heaping up his dirty moraine in every eastern nook and corner he could find.

But to come to particulars. Take the coast line from Sewerby to Spurn. It is retreating slowly westward before the slow but persistent attacks of denudation. Holderness is simply a mass of boulder clay and drift, filling up an ancient bay, whose shores once extended from Sewerby, round by Kilham, Craike Hill, Middleton, and Beverley, to the Wolds of Lincolnshire. The sea is re-asserting its rights, and fortunately we have a gauge by which to measure the rate of progress.

In the year 1786 Polson, writing his valuable history of Holderness, recorded the distance of certain churches from the edge of the cliff. It is to be presumed that he measured from the east end of the chancel in the nearest straight line to the cliff top. Capt. Kenney, R.E., of the new Ordnance Survey, has kindly forwarded the exact distances of the same taken in 1889. From these reports the following table has been constructed :—

	Distance from cliff top. 1786	1889.	Total loss in 103 years.	Average per annum.
Hornsea Church	3399 ft.	2695 ft.	704 ft.	6 ft. 10 ins.
Aldborough ,, ...	6132 ,,	5604 ,,	528 ,,	5 ,, 1½ ,,
Tunstall ,, ...	2772 ,,	2075 ,,	697 ,,	6 ,, 9 ,,
Holmpton ,, ...	3600 ,,	3145 ,,	455 ,,	4 ,, 5 ,,

Hence it is evident that erosion varies on different parts of the coast, probably owing to the temporary formation of sandbanks and deflection of currents. This is corroborated by a remarkable instance in the case of Auburn House, communicated by Mr. T. Boynton, late of Ulrome. "Some thirty years ago part of this house was removed by the sea; none has gone since, a sandbank having formed above high-water level." An extract from the terrier belonging to the parish of Atwick, kindly contributed by the Rev. E. Gordon, vicar, tends to the same conclusion. For nine years previous to the year 1795 the average loss of the cliff was 10 ft. 4 in. per annum. In 1795 the distance of Atwick Cross from the cliff top was 2,865 feet. In 1871 it was 2,508 feet; an actual loss in 76 years of 357 feet, or an average of only 4 ft. 8 in. per annum.

During the past year the hon. secretary has taken several measurements at different points on the coast, which will be placed on permanent record with the Y.N.U.:— *e.g.*, Bempton Cliff, above Scale Nab; Sarnwick, near Thornwick Bay; Sewerby, opposite Sewerby House; Sands Cottage, near Bridlington Quay; Filey Bay, and Carr Naze. At the latter place the capping of boulder clay (80 ft), resting on the middle oolites, is being rapidly destroyed—partly by the rainfall, partly by the heavy waves breaking on the northern face of the rocks. The narrowest portion of Carr Naze on the top measured only 224 inches on August 6, 1889. In no very distant time this will be cut through, and the appearance of the Brigg materially altered.

Captain Kenney, R.E., has kindly been at the trouble to furnish measurements in Holderness, which will be of great use in furnishing fresh data for future generations.

The House Sparrow

(Passer domesticus).

By Charles Potter.

THE minds of the farmer and gardener have long been exercised to prevent the ravages of this bird. The excellent letter in *Research* of May last, by Lucy J. Halcrow, stamps the writer as an excellent observer, and her practical suggestion that the examination of the crops of these birds should settle the question as to whether they assisted in the "balance of Nature" by the destruction of insects is easy of proof by those interested. It is fully forty years since I carried out examinations of sparrows' crops for a period of two years, in the county of Sussex. Many hundred crops I examined, the birds being mostly shot in the evening just before going to roost, or netted after they had gone to roost, the crops being at that time the best filled, my experience being that, in the severest weather, the sparrow seldom goes hungry to bed.

On three occasions, and three only, did I find caterpillars in the crops of these birds, the most I found in any one being three. I have seen occasionally a sparrow pursue an insect on the wing, but I never found a winged insect in the crop of one.

A few years since, some plants in front of the house in which I now reside were badly infested with the green-fly. To my surprise, a hen sparrow which, I have no doubt, had a brood of nestlings at the time, was most assiduous in picking off these insects.

On several occasions I watched this bird, when many sparrows of both sexes were hopping about, or on a tree in close proximity, but not one gave the slightest attention to this bird, or to the insects it was collecting, nor have I ever seen, before or since, one so employed.

Lucy J. Halcrow points to the destruction worked by the sparrow to the flowers of the crocus and primrose. There are few growers of these plants who have not similar complaints to make, and the way in which they leave one plant or flower, for a newer or fresher, is proof of their delicate taste, and love of variety.

The primrose is neglected for the apple, the pear, and other blossom, and these for the succulent pea as it peeps out fresh from the surface soil; these in turn giving way to the young green gooseberry, the latter, with the currant, elder-berry, &c., being equally sought in the ripe state. From these the sparrow betakes itself to the fields of corn, which are by that time ripening. About the month of October, the corn fields being well gleaned, the sparrow returns to the gardens, and great is the destruction it then works on the fruit buds of the white, red, and amber currant which are at that time developing. The buds of the black currant they do not relish, but reserve their depredations for this fruit when ripening the following year. The mischief and enormous pecuniary loss to the agriculturist, and the horticulturist, neither commence nor end with the direct destruction to crops. No greater enemies are to be found to the purely insectivorous swallow tribe. These beautiful and always welcome summer visitants, the common swallow and house martin, return year after year to their old breeding places, too often to find their nests occupied by the sparrow which they have no means of ejecting. Many are the breeding places from which these favourite birds have been driven in this country by these common pests. When the oil storages were made at the Herculaneum dock, at the south end of Liverpool, a considerable surface of rock was left exposed above them. Much of this being of the blown or drift sand, common to the triassic rocks, was soft enough for the little sand martins (*hirundo riparia*) to make their holes in. The first year after the oil storages were finished, a colony of these beautiful birds established themselves there, and for a few years went on increasing in numbers, but with the extension of the docks southwards, and discharging of grain cargoes in them, the sparrows

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have increased in numbers until they have completely driven the martins away.

The martins put in an appearance last spring, only to find every hole made in the previous years occupied, and as soon as they made another it was taken possession of by the sparrows, with the result that after about a fortnight's struggle they entirely left the neighbourhood. This is to be regretted, as I question whether another colony of these interesting summer visitants will be found within the city boundaries.

Good work has been, and is being done by the entomologist in describing the insects injurious to cereals, fruit, &c. Often, artificial means are suggested for destroying these enemies of the husbandman. Yet, how little does the latter endeavour, by observation, to ascertain which, amongst the creatures surrounding him, are his greatest natural aids to that end.

In that most harmless of creatures, the toad, he has one of the best assistants in the destruction of slugs, snails, and insects. Yet, instead of protection being extended to the toad, it has only to be seen by most boys to be stoned.

When the beautiful titmice are seen in the winter months, full of life, and twitter on leafless fruit trees, or the bare walls, the dullest of observers may, if he gives them a thought, be certain that in the insect food they are seeking they are assisting to exterminate the enemies of the next year's crop.

Our summer visitants, from the cuckoo to the smallest warbler, should be all carefully protected and preserved as insect destroyers. Above all as the destroyers of rats and mice. No bird should be more carefully protected and encouraged than the owl. Many are aware that the indigestable portions of the owl's food, such as feather, fur, and bone, are not passed through the stomach, but accumulate into a lump or pellet, and after it has attained a certain size is ejected from the mouth. From one of these pellets, ejected by the common or barn owl, I obtained two lark and nine mice skulls.

Some birds, such as the blackbird and that sweet singer the thrush, are very destructive to ripe fruit, especially the pear and the cherry, but the mischief thus caused is probably much more than compensated by the quantity of worms, slugs, and snails they consume, in the destruction of which few birds equal the starling.

One cannot but feel that the President of the Board of Agriculture might materially assist the spread of knowledge respecting our feathered tribes. A small book written in a popular style, pointing out the common British birds and reptiles, such as the toad and the frog, most useful to man, showing how they may be preserved, and their numbers increased by them and their eggs being left undisturbed, might be introduced into all our Government grant schools, the masters being instructed to bring them to the notice of their scholars. It may be hoped that such a course of instruction would assist the powers and love of observation in the rising generation, and be the means of rendering service to the tillers of the soil, for which the Board of Agriculture has been so wisely established.

Since the above was written, a friend writes me from Meliden, North Wales (14th March), as follows:—

"Our gardens are too forward. The buds of pear trees have all been eaten by the birds. The apples, currants, gooseberries, &c., are very forward. These we don't care much about, having so many, but we do begrudge the birds eating the buds of the plum, damson, nectarine, cherry, &c., but more particularly the peaches."

Foreign Jottings.

In St. Petersburg a hydrographic institute is to be founded at the instance of the Academy of Sciences. At Baltzi, the other day, in Bessarabia, a coach was attacked by wolves, which killed the five occupants and the horses. The 250th year of the existence of the University of Finland occurring this year, the event is to be celebrated with great ceremony.

The University of Montpelier, next after those of Paris and Toulouse, the oldest in France, will celebrate the 600th year of its existence in May next, with great ceremony, nearly all foreign Universities sending delegates.

Ararat, the famous mountain in Armenia, has been ascended by a young Russian lady, Mdlle. Mokossowitch, 17 years of age. She was accompanied by her father, and three Kurdish guides, but the former became exhausted at an altitude of 16,750 feet, and, upon reaching the top, the young lady fainted. This is the first time that the celebrated mountain of the Bible has been climbed by a woman. It was ascended for the first time in 1829 by a Russian Naturalist, M. Parrot, but since several others have performed the feat.

The African Continent has now been traversed thirteen times from either side. The first was, as is well known, Livingstone, who was followed by the Portuguese Silva Porto, in 1873 by Cameron, in 1874 by Stanley, in 1877 by Major Serpa Pinto, in 1880 by the Italian Mattucci, in 1881 by Captain Wissmann and the Scotchman, Arnot, who traversed from East to West. Again, in 1884, the two Portuguese explorers—Ivens and Capello—traversed the Continent, and the Austrian, D. Lenz, and, in 1885, the agent of the Congo State—the Swedish Lieutenant Gleerup. Since then Stanley and Wissmann have performed a second journey, and, since the former's return, the French Captain Trivier has also performed the task.

The amber fisheries on the coast of Prussia now yield some £32,500 annually, and employ 2,000 men. They are in the hands of contractors. The German East African Company has engaged Dr. Baumann to measure the area of land possessed by that company, there being no reliable map. He has, therefore, proceeded to Africa. In 1888 Dr. Baumann, who has drawn a good map of the regions of the Lower Congo, proceeded with a *confrère* to Kilimanjaro, where they were made prisoners by the notorious Buschiri, a chief recently shot by Capt. Wissmann, and only released upon paying a ransome of £1000. According to the researches upon the influenza by Dr. Ziemssene, of Munich, the epidemic is greatly accelerated by a sudden rise in temperature, whilst steady, severe winters counteract it.

The Swedish Geographical Society has conferred the *Vega* Gold Medal, the greatest honour at its disposal, upon Emin Pacha. Unfortunately, no traces can be found of the great meteor which fell near Söderhanm, on the Baltic, on Nov. 26 last, and which was seen over the entire part of Central Sweden. The light was at first intensely white, then becoming blueish, and leaving a trail behind. The course was N.E.-S.W. At the meeting of the Swedish Geological Society, Prof. Nordenskiold exhibited the great meteorite which fell April 3, 1888, in Scania, acquired by the National Museum. The fall was accompanied by a roar like artillery. It is the size of a man's head, very heavy, and with a glazing outside, usually caused by friction with the air. It is, however, evidently only a fragment, composed of chondrite and pellets of metal It seems to belong to the so-called "Hessel" class, and hails from the same locality in space. It is the sixth meteorite found in Scandinavia. The other day the town of Grenna was distinctly seen in a mirage thirty-five miles distant, the phenomenon lasting fifteen minutes. All the furniture from the workroom of the famous John Eriesson has been added to the Northern Museum. An important expedition in the Cattegat and Skagerack has just finished its task, consisting of five steamers and eminent *savants*, for ascertaining the hydrographical conditions of these waters in winter, an exploit never before carried out. The result is valuable. Prof. Hildebrandsson, Director of the Upsala Meteorological Institute, is collecting material for ascertaining the time of the appearance of the influenza in all parts of Sweden. It is curious to note that January 20, marked by Dr. Falb as a "critical day" of the first order, was accompanied by a terrific snowstorm, the worst of the season, all over Sweden and the Baltic.

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PREPARATIONS are being made for the Danish expedition to Greenland next year, which is to be in command of the well-known Arctic explorers, Lieuts. Garde and Ryder. The expedition will be conveyed early in June in the sealer "Haardraade" (Captain Jakobsen, who last year commanded "Jason," of the Nansen expedition), to Scoresby Sound, in lat. 70° N., where attempts at landing will be made. The object of the expedition, which will be absent three years, is to explore the extreme unknown north-east coast. In order to ascertain the wanderings, growth, &c, of the flounder, the Danish Inspection of Fisheries caused 400 of these fish last year at the Scaw to be marked with a tiny metal chip in one fin, but up to the present only nine of these have been caught, and in wretched condition, so that no doubt the mode of marking is injurious to the fish.

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APROPOS of Spitzbergen, Professor Kükenthal has given an account before the Berlin Geographical Society of his explorations last summer. He found that marine animal which lived at great depths further south where also found around Spitzbergen, but in much shallower water, showing that they are independent of pressure, but guided by temperature. At the Bastian Islands remains of animals and plants were found, indicating that an arm of the Gulf Stream flowed thither. At the Carl's Island, separated from Spitzbergen by a channel 100 fathoms in depth, enormous quantities of walrus were met with, so that there seems no fear of their extinction. Polar bears and reindeer were also numerous, and these were so tame, that the hunters could approach quite close, having no doubt, never before seen human beings. The bears did not even attack when wounded. The state of the ice was very favourable for research in the north. Close by a glacier, christened Nansen's Glacier, hundreds of walrus skeletons were found, they having no doubt stranded through ice pressure. The whole of northern Spitzbergen is described as one enormous glacier, rising to 2,000 feet, the reflection of light from the same being observable at a distance of 50 geographical miles.

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IN Norway an earthquake, accompanied by a violent storm, was felt on February 22nd, in several parts of the west coast. The rainfall in Bergen last year (said to be the most moist spot in Northern Europe) was 56·3 inches, or a few inches above the average. During the four summer months, the fall was only 6½ inches. An interesting map of Lapland and the White Sea, carefully executed, and dating from 1601, has been discovered by Baron Nordenskiöld in Skokloster library. Meteorology is making great progress in Norway. Thus of 100 warnings issued in 1883, 83 were correct, and 17 failed; in 86 and 14 respectively; in 1887, 89 and 11; and in 1889, 91 and 9. They are proving of great value to the agriculturist. Professor Friis, the well-known ethnographer, has issued a remarkable map over Finmarken, showing the limits of vegetation, rivers where the sea salmon enter, and how far, fishing grounds, the grazing of the reindeer, &c. It appears that the northernmost spot in the world where the pine is found, is the Börs river, in the Porsanger fjord, lat. 70° 22′. At the meeting of the Society of Sciences of Christiania, Dr. Mageissen read a paper upon the periodicities of the temperature, which recent researches have shewn to comprise about 12 days. There are also periods extending over several years. He maintained that these periods correspond with others of sickness and epidemics that occur in various countries, and produce the variable *Constitutis epidemica*. The area of the Norwegian state forests is estimated at one million hectares, and valued at £800,000. The new government is taking special steps to protect the forests from utter destruction. *Apropos* of the discovery of America by the Norsemen, a monument now marks the site of their first settlement, Norumbega, on the Charles River, where remains of it exist. However, Professor Horsford has shewn that the Norse "Vinland" was not, as supposed, Virginia, but Massachusetts.

Our Portrait Gallery.

XX.—THE LATE MR. S. A. ADAMSON, F.G.S.

OUR readers will share in our own expression of deep regret at the loss of an esteemed contributor, Mr. S. A. ADAMSON, the well-known geologist, of Leeds, who died somewhat suddenly from pleurisy, following upon an attack of the influenza. Yorkshire geology and geological literature suffer a great loss by the death of one who was a most enthusiastic worker for his favourite science. Through the courtesy of Mr. J. E. Bedford, F.G.S., President of the Leeds Geological Association, we are enabled to present our readers with a portrait of Mr. ADAMSON, reproduced from an original negative supplied by Mr. Bedford.

SAMUEL ARTHUR ADAMSON was the son of Mr. Joseph Adamson, former gas manager at the Leeds New Gas Company before its purchase by the Corporation. He entered the office of the Leeds New Gas Company as a boy twenty-nine years ago, and gradually rose, both before and after its purchase by the Corporation, until he attained the position of chief clerk. Taking a deep interest in natural science, he attached himself to the geological class at the Yorkshire college, under the tutorship of Professor A. H. Green (now of the University of Oxford), and became a constant attendant at the excursions conducted by that gentleman, profiting by the thoroughly practical teaching there conveyed, and learning his physical geology in the only place in which it can be effectively studied—namely, in the field. He made a special study of the Coal Measure, Liassic, and Oolitic formations, all of which are well developed in Yorkshire. He read the story of the earth's history as written in the rocks, and saw the beauty and harmony of the whole with an admiration which, with an able pen, he so graphically described for the benefit of the public.

Nature, which designed him for a poet, made him a geologist, but he brought his poetical fancy to enrich the hard facts of science, and thousands have read weekly his descriptions of meetings and excursions with an ever-increasing love for the science and esteem for the writer. Here is a description of the view from Wrose Hill on August 2nd, 1884, extracted from the proceedings of the society he loved so well:—"The party ascended Wrose Hill, some 800 feet above the level of the sea, and were amply repaid for the labour of the ascent by the magnificent prospect spread before them, whilst the westerly breezes, laden with ozone, brought the hue of health to the most pallid votary of science. It is a wonder that a beautiful position like this, so easily accessible from Idle or Shipley, is almost a *terra incognita* to Leeds people. It is only some nine miles distant,

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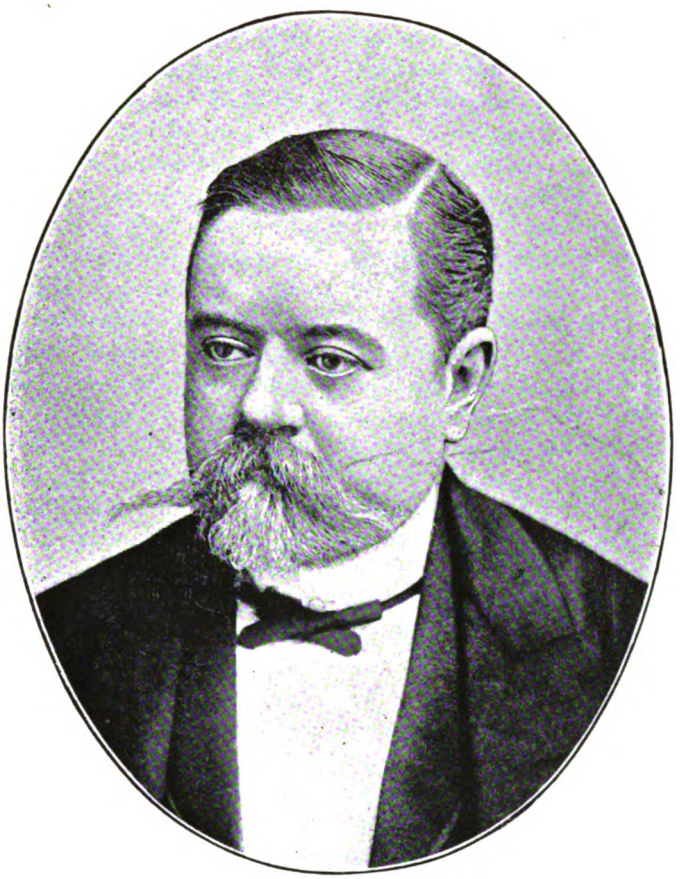

THE LATE MR. S. A. ADAMSON, F.G.S.

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and yet how few in our town have heard of it, much less ascended it. The atmosphere was clear, and the delighted eye passed westward over moorland and meadow, hill and valley, crag and woodland till the splendid vista was closed by far-off Pendle, in Lancashire; to the north a peep into Wharfedale was afforded: in front and eastwardly, as far as the familiar spires on Woodhouse moor, the beautiful valley of Airedale spread itself, full of natural beauties of the most exquisite kind, indeed one might fitly imagine the Cistercians of old viewed the valley from this spot, before fixing upon their beautiful retreat at Kirkstall; to the south lay busy Bradford, crowned by the heights of Dudley Hill, this never-to-be-forgotten prospect, seemed shut in by such a sense of isolation on the hill top, that we felt we were indeed in nature's classroom." "The thought," he says on another occasion at Norber, surrounded by those great torn blocks "was stupendous, that here in this nineteenth century, we students of science were gazing upon fragments of an age removed from us by a period of time which, to our finite minds, is so vast as to be practically illimitable." At another time his friend Mr. Cheetham conducts a party to Chapel-le-dale, where is "a waterfall more savage in its grandeur and more gloomy in its character than Thornton Force. The dark deep pools, with their lofty and overhanging precipices surmounted by gaunt and leafless tress, and the contrast of the rushing sound of the angry waters with the intense solitude all round, all combined to produce an effect most impressive in its character, and a feeling of awe at the sublimity of the mighty works of Nature before us. This reverent contemplation of the handiwork of the Creator tends to refine and expand the intelligent and enquiring mind, and is one of the many advantages to be derived from the study of geology."

Mr. ADAMSON had also a very practical side to his character, and no one knew better than he that it is only by hard and continuous effort that interest in a good cause can be generated and extended; he was ever most energetic in the spread of a knowledge of science; and even in remote localities, and perhaps not under the most favourable circumstances, his enthusiasm spread to those who were for the time his associates. Many a small society has been stimulated to activity by his advice and example, and not a few have owed their existence in a large measure to his initiative. After a visit to Pateley in 1884, he writes: "A spirit of geological enquiry has recently sprung up in Pateley, which it is to be hoped may result in the formation of a society similar to the Leeds one. The number of Pateley gentlemen evincing their interest in the science would form the nucleus of a most successful society." A vein of humour, of the quiet and sympathetic kind, also pervaded his nature, and many a quaint expression has alleviated the tedium of a homeward march after a long tramp. On one occasion "the excursion was not devoid of a spice of adventure, for in crossing a brook by means of stepping-stones, one well-known member suddenly found himself on his back in mid-stream, presenting a remarkable similitude to a turtle."

Mr. ADAMSON became a valued member of many scientific societies. The Leeds Geological Association of which he acted as the hon. secretary, is particularly indebted to him, and will feel his loss greatly indeed. The success which has attended the career of the association has been due, in a great measure, to his untiring zeal, and the valuable volumes of transactions issued since 1883 have been edited and to a large extent written by him. A visit which the association paid to investigate the history of the Hitching-stone, an isolated block of gritstone on the moors five miles west of Keighley, led to the formation of the Yorkshire branch of the Erratic Boulder Committee, of which Mr. ADAMSON was honorary secretary. He occupied the office of honorary secretary to the geological section of the Yorkshire Naturalists' Union; the proceedings of that section as published, were written by him. Mr. ADAMSON was a member of the committee appointed by the British Association for the Collection, Preservation, and Systematic Registration of Photographs of Geological Interest in the United Kingdom, and Mr. Jeffs, the secretary of the committee, has found Mr. ADAMSON'S practical knowledge and effective support of the greatest value; he was also a vice-president of the local committee with the same object.

Mr. ADAMSON was the local secretary for the Leeds district of the Yorkshire Geological and Polytechnic Society, of which he was also a member of the Council. He has published papers in its "Proceedings." He described sections which had been revealed by the excavation of a gas-holder tank near Barnsley, consisting of silt, gravel, and clay, resting on Middle Coal Measures, and containing the remains of beetles, fresh water shells, and plants. In the same gravel a remarkable implement was found, composed of mica-schist, smooth, and having at its sides peculiar groovings which had evidently been produced by man.

The formation of a line of railway from Ilkley to Skipton afforded Mr. ADAMSON an opportunity to study the contorted limestones and shales of the district, and the superincumbent glacial beds. A description of these beds formed the subject of a paper to the society, which was published. He also contributed papers to the Geological Society of London, of which he was a Fellow, to the British Association, whose meetings he regularly attended, and to local societies on a variety of subjects, perhaps the most important being on the discovery of fossil tree roots and stems at Clayton, in the Lower Coal Measures.

His contributions to our own columns were numerous, and were highly appreciated by all who read them. His descriptive powers, and the faculty of imparting a mass of real information in an attractive manner, were of a high order, and rendered more valuable by the intimate knowledge

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possessed by him of the geological features of the several districts which he undertook to describe.

Added to these gifts a seemingly unlimited capacity for work and specially good organizing abilities were some of Mr. ADAMSON'S distinguishing qualities. No excursion of the Leeds Geological Association, or of the Yorkshire Naturalists' Union, was complete without his genial presence. It was expected that he would have taken a very active part in the next meeting of the British Association, which is to be held in Leeds, and his loss will, on that occasion, be much felt. His kindness and geniality made him as much esteemed in private life as he was by his scientific friends.

Notes in Brief.

MR. THOMAS WARD, J.P., of Northwich, has just related to the Manchester Geological Society the history of his recent visit to the salt deposits of the United States. In the space of three weeks Mr. Ward travelled over 4,000 miles of territory, and inspected over fifty separate salt works, and he was greatly impressed by the enormous extent of the salt deposits and their diversity of geological age.

PROFESSOR E. GERARD, of Liège, has applied photography to plotting curves. The swings of an oscillating body—for example, the needle of a galvanometer on either side of the zero line—can be traced and recorded upon sensitive paper. An induction spark is passed between a strip of magnesium and a carbon point, so as to produce a small arc, or rather a rapid succession of arcs. These sparks are reflected from a mirror attached to the oscillating needle, and impress their image on a moving scale of photographic paper, producing a wavy row of dots which undulates about the zero line, as the needle oscillates from side to side.

THE utility of establishing stations for recording observations of the weather at various points of the earth's surface has been attested of late by the erection of several stations of this kind both at home and abroad. Even the Japanese are fully alive to the importance of obtaining careful records of local meteorology, as the only basis for the study of the climate of a given region, the outcome of which is seen in their recent decision to establish an observatory on the Loochoo Islands, where such a station will be specially useful for observing the phenomena in connection with the course of typhoons.

THE list of prospective prizes for 1890-93 offered by the French Academy of Sciences, includes one of 3,000fr. for an important perfection in the theory of differential equations of the first order and degree; an extraordinary prize of 6,000 franks for a work tending to improve the French naval forces; two prizes on applied mechanics. Three La Caze prizes of 10,000fr. each will be awarded next year for memoirs or works which have contributed most to the progress of physiology, physics, and chemistry. Another large prize in organic chemistry is the Jecker of 10,000fr., awarded annually. The most valuable of all is, however, the Bréan prize of 100,000fr. (£4,000) for a radical cure or preventive of Asiatic cholera. Among the general prizes is the Argo gold medal for any real service to science, the Montyon prize for a means of rendering some craft or business less unhealthy, and the Leconte prize of 50,000fr., open to all comers, for a work or invention in mathematics, physics, chemistry, natural history, or the medical sciences. It will be awarded in 1892.

THE marine meteorological service established in Cuba has received the approval of the Spanish Ministry. Its headquarters are at Havana, but there are stations along the coast of Cuba and Porto Rico. The director is Captain Luis y Carbonell.

SEVERAL boulders of large size have been found in the cutting of the Ship Canal opposite the Salford docks. They are composed of carboniferous sandstone, and lie on the top of the boulder clay, enclosed by river gravels. One of the boulders weighs nearly six tons, and still retains some vestiges of the ice scratchings it received during its transport hither by glacial agency.

A REMARKABLE fall of meteorites was observed in December last at Jelica, in Servia. The meteorites fell over an area of eliptical form, spreading from the Jelical mountains towards the river Morawa, and enclosing several villages. The area is five miles long, and about three in breadth, and there fell upon it twenty-six meteorites, weighing in all nearly eighty pounds.

THE phenomenon of "mock suns" was witnessed recently at St. Malo, when three suns were seen in a row, a little above the western horizon. The sky was very clear at the time. The central luminary shone with unwonted brilliancy while from its supporters darted rays of all prismatic colours. At the same moment a rainbow made its appearance at some little distance, but upside down with its convex towards the horizon.

AN interesting paper on photographs of wood sections obtained by the microscope was recently read before the French Photographic Society. M. Thil, Inspector of Forests in France, has pointed out that such photographs permit the trees which furnished the wood to be classified, thanks to the structure of the cells and the fibres of the timber. Thin cuttings of any wood compared with standard photographs enable it to be identified at once.

DURING the excavation in the year 1824, through the east hill of Dartford, a ponderous stone sarcophagus, probably of the Roman period, was unearthed. On being opened it was found to contain female remains, which crumbled into dust on exposure to the atmosphere. It came into the possession of the Landale family, but having been surrendered by Mrs. Hall, in conjunction with the Kent Archæological Association, it has been transferred to the custody of the Vicar of Dartford, who has had it conveyed to the vestry-room of the parish church, where it now lies awaiting a little necessary cleansing. The sarcophagus has been viewed by Mr. George Payne, F.S.A., of Sittingbourne, who was, however, unable to closely fix its date. The massive receptacle weighs upwards of a ton.

THE Liverpool Astronomical Society, like some other institutions, has discovered that frequent change of officers is not conducive to good management, nor is the enthusiasm of its members maintained at a height by the much-delayed appearance of its monthly journal, which, under the *regime* of Mr. Davis and Mr. Isaacs, always filled a regular and welcome place on the library table. The late Father Perry, who, on the eve of his departure for the West Indies was elected president, took a deep interest in the society, and there is no doubt that, if he had lived, he would have energetically developed its usefulness. At this juncture it is gratifying to learn that the reins of secretarial management have been taken over by Captain A. W. Jeffry F.R. Met. Soc., who may be expected to clear the ground of all difficulties, and soon place the society on a strong footing. The Liverpool Astronomical Society has a roll of nearly 700 members and possesses a good library; it should not suffer from inadequate financial support, and there is no reason why it should not maintain a leading position among our scientific associations.

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THE committee of the Palestine Exploration Fund have, after a delay of nearly five years, received their firman granting permission to excavate at and about a site previously named by the committee, and approved by the Porte. Mr. Flinders Petrie will accordingly proceed to Syria on completion of his present work.

A VALUABLE field of nickle ore has been discovered near Frankenstein, Upper Silesia. There are at least eight lodes, varying in thickness from 18 in. to nearly 7 ft. There is another deposit south of the village of Baumgarten, and it is thought the two are connected. If this be so, the dimensions of the whole field are about 6½ miles long by 750 yards wide.

MESSRS. LONGMANS & CO. have issued their quarterly catalogue of new books, which, we observe, contains several important scientific works. Among these we may mention *The Skipper in Arctic Seas*, by W. J. Clutterbuck, with map and 39 illustrations; Professor Thorpe's *Dictionary of Applied Chemistry*; *The Elements of Laboratory Work*, by A. G. Earle, M A., F.C.S., a new course of Natural Science; and *Electrical Engineering for Electric-light Artisans and Students*, by W. Slingo and A. Brooker; with 307 illustrations.

A NEW use has been found for the phonograph by Dr. J Parker Smith, of Dulwich. He says that "the phonograph is admirably adapted to secure the natural sounds of rivers, trees, and other natural objects under definite circumstances which the scientist can once more repeat in his study with all the fidelity with which they lisped or thundered out those sounds, which primitive man in pre-historic times used as a language of imitation, and the fundamental elements of which are crystallised in the classical languages of India and Europe, and in the modern languages derived from them."

THE latest phonograph story which Colonel Gouraud has brought home is rather a good one. It is told about one of Mr. Edison's assistants who, being some distance from home, was accustomed to communicate with his family by the assistance of the phonograph. He spoke his thoughts into the phonograph, took out the wax cylinder on which his words were impressed, and posted it home. On its arrival it was placed in the phonograph, the machine set revolving, and the message came forth. The absentee had a favourite dog, to which he was much attached. In one of his "phonographings" he sent his love to the dog, finishing with a whistle. The dog was lying quietly on the hearth while the message was being read, but when the whistle came forth it jumped up, bounding all over the room, and out at the door to look for the master, whose signal it had heard.

IT is to be regretted that science receives so little encouragement at the hands of certain of our professors. In a recent address Professor Blackie stated that he did not see what good was to be derived from the knowledge of the length of time which light takes to travel from the sun (!). Professor A. J. Church, in *Atalanta*, regards with dismay the "changes that are going on in our system of education (it must be understood that I am speaking now of the education of boys), the proposals for changes still more radical in the future that are being made by persons of standing and influence. Scientific education is a much more formidable enemy. I do not scruple to call it an enemy, because I am sure that if it drives out, as it seems likely to drive out, its literary rival, the result will be simply disastrous to culture in England. . . . Charles Darwin tells us that in his youth he was passionately fond of poetry, but that in his old age, after a life devoted to that habit of observation in which he was unsurpassed, he could not endure to read a single verse, and that his taste for art and music had suffered nearly the same eclipse. Imagine a society in which the same pursuits had universally produced the same result! What could be more appalling?"

MESSRS. CASSELL & CO. will shortly publish a work by R. Kearton on "Birds' Nests, Eggs, &c.," with sixteen coloured plates. A carefully written introduction will embody the results of a minute study of some of the most interesting features of bird-life.

MR. JAMES SAMUELSON, a well-known citizen of Liverpool, and President of the Liverpool Science and Art Classes, who is not only appreciated in literary circles, but has done much to further science instruction in Liverpool, is intending to start a new Quarterly Review. In addition to other works of note, Mr. Samuelson recently published an important work, entitled *India, Past and Present*. Sir William Hunter's co-operation is promised for the first issue of this new venture, which is to be published by Messrs. Routledge.

THE preliminary programme of the British Association meeting at Leeds in September next has been arranged, and it has been settled, so far, that the evening discourses will be delivered by Mr. C Vernon Boys and Mr. E. B. Poulton, while the Saturday evening lecture will be by Professor A. B. W. Kennedy.

THE HON. RALPH ABERCROMBY, some months ago, succeeded in measuring the height of some high ocean waves by flotting an aneroid barometer upon them; but during the recent gales a practical result was got in quite another way. The Dundee screw steamer "Croma" shipped a sea down her funnel, which is fifty-six feet above the ordinary water level. What with this adventure and the measurements of Mr. Abercromby, it is tolerably certain that waves are sometimes fifty or sixty feet from trough to crest.

FOR some months past Mr. Murgatroyd, of Stockport, has been sinking and tunnelling at Middlewich, Cheshire, endeavouring to discover salt. Soon after sinking operations commenced the men came upon the first regular bed of salt, nearly 60 feet thick, and 12 yards further down they entered the second bed. Upon boring 56 feet into the second bed they found amber rock-salt of very fine quality. They then made a tunnel to the rock head, and have now completed a series of valuable discoveries by striking a plentiful supply of brine. The brine burst into the shaft with a tremendous rush, and the manager and three men had to beat a hasty retreat. The brine is found to be fully impregnated with salt, containing, indeed, 2 lb. 10 oz. per gallon.

THE International Geological Congress, which met in London two years ago, provided material for a copious report, which, it is hoped, will shortly be ready. It will form a volume of upwards of one thousand pages, with numerous illustrations, including five geological maps. To meet the cost of completing and distributing this report the committee are under the necessity of applying for further funds. It would be greatly to be regretted if the important work of the Congress should not receive adequate assistance from British geologists. Subscriptions for this object may be sent to Mr. W. Topley, F.G.S., secretary, 28, Jermyn Street, London.

THE largest plant-fossil in Europe is at present being exhibited at the Berlin Berg-Akademie. It was discovered in 1884 in the coal mines of Piesberg, and sent to Berlin by the chief magistrate of Osnabrück. With great difficulty the huge mass was cut out of the earth in which it was imbedded and carted away. The fossil is a piece of a gigantic ancestor of the ordinary *Lycopodium* of the present day, a variety distinguished by the name of *Sigillaria*. It consists of a trunk about one metre in diameter, which divides at the bottom into several forklike strong roots, rung horizontally. The surface of the trunk shows a graining in the form of long ridges. The bark is still traceable in places, in charred-looking remains. Many of the roots show the marks where formerly grew the long cylindrical suckers which supplied the plant during its lifetime with nourishment.

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THE Vicar of Chapel-en-le-Frith seems determined to destroy the chancel of his church—a chancel of peculiar interest which it is quite practicable to preserve, and which the Archæological Society of his own county has implored him to spare.

FURTHER explorations are contemplated by Dr. Schliemann at Troy, which he hopes to complete within two years. He will first excavate the region outside Pergamon, and the ways from the three gates into the lower part of the city. His work will be greatly facilitated by the construction of two railways for the removal of the rubbish.

THE members of the Liverpool Sunday Society have presented one of their honorary secretaries, Mr. R. McMillan, with a gift of £125, in recognition of his valuable services during the past four years. Under the signature of "R. M.," Mr. McMillan has contributed a long series of articles on scientific and social subjects to the *Liverpool Mercury* and other journals, and as a popular lecturer on science topics and in other ways he has worked energetically in the furtherance of scientific studies.

THE Derbyshire Natural History and Philosophical Society, which has been in existence for some years, has now been amalgamated with the Derbyshire Archæological and Natural History Society, and a sub-committee has been appointed to carry on the natural history work of the county. Mr. George Hyde, Osmasmaston Road, Derby, is the secretary.

THERE is in the press and will shortly be issued by Mr. W. A. Harris, a book entitled *Harris's Technological Dictionary of Insurance Chemistry*, written by Mr. W. A. Harris. A previous edition of this work has proved itself of very great service to insurance agents and others, and, no doubt, the following work will be in advance of its predecessor.

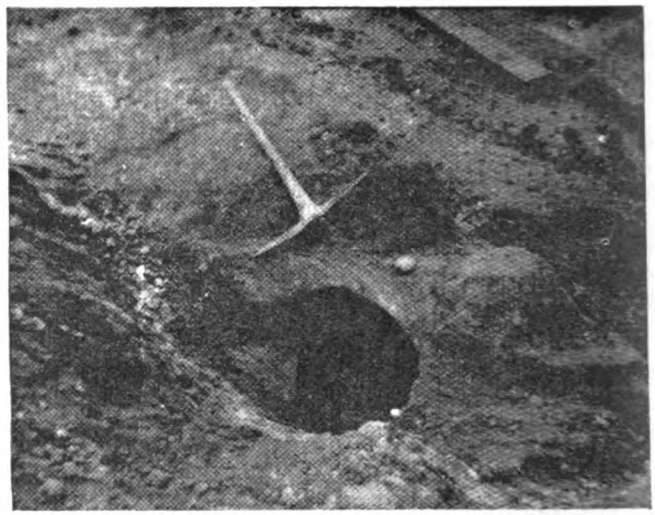
A SERIES of experiments have been made by M. Adolphe Minet in the works of MM. Myrthel and Ernest Bermond, at Creil, in France, on the manufacture of aluminium by electrolysis. Alumina or fluoride of aluminium is fused by heat and then decomposed by passing an electric current through it. In this way 35 grammes of the metal aluminium is obtained per horse-power of energy expended. Several tons of aluminium have already been isolated in this manner.

DR. NANSEN, the Arctic explorer, has laid before the "Geografiske Selskab," at Christiania, his plans for a North Pole expedition. The doctor advocates the employment for this purpose of a ship, built with a special view to strength, and having its sides constructed at such an angle that, instead of being crushed by the ice, the vessel will be raised by it. The vessel should also carry a large supply of provisions and warm clothing. The route proposed by Dr. Nansen is through the Behring Straits, where advantage is to be taken of the favourable current to carry the vessel northward, and thus attempt to reach the new Siberia Islands as soon as possible. Here the vessel would enter the ice floes and would proceed towards the North Pole, in which direction the current would probably carry it.

Geological Sections on the Manchester Ship Canal.

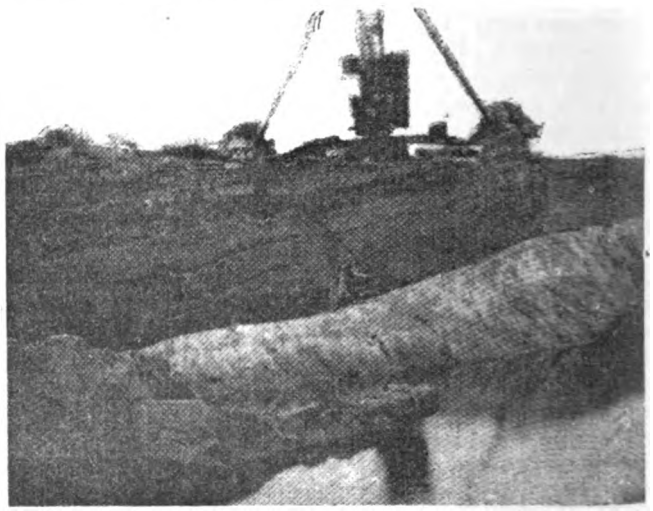
I.

THE progress of the great undertaking which is now engaging the interest and attention of Lancashire men, has afforded some excellent opportunities for the study of the geological characteristics of the country through which the canal bed is being excavated. Sections have been exposed in the post-pliocene and recent deposits, drift sands and boulder clay, and in various strata of the Trias. Whilst many details have been corrected or verified, upon the whole, little has been discovered that was not already known. Many of the sections in the drift, and in the Red Marl and Bunter formations exhibit features, however, of great geological interest, and it is fortunate that, through the ardour and perseverance of one of the most active members of the Manchester Photographic and Microscopical Societies, photographic records of many of these features have been preserved. Mr. Edward Ward, of Oxford Street, Manchester, has occupied himself with the gigantic task of photographing the canal works in its scientific, no less



SECTION AT BARTON (WITH "POTHOLES.")

than in some of their social aspects, and has thus rendered a distinct service in recording all that is worthy of note in the excavations so far as they have proceeded. We are enabled, through Mr. Ward's courtesy, to reproduce two of his geological photographs, the first of which shows the drift sands and river gravel at Barton, with one of the curious "pot-holes" which occur there. The other photograph exhibits a section of



"SLICKENSIDE" ON FACE OF FAULT AT NORTON.

the waterstones at Norton, exposing the "slickensided" face of a fault. These "slickensides," or polished surfaces of faults, are very numerous in the Triassic rocks, and are deserving of study, as throwing light on the direction and character of the movements which have affected the local strata.

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Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between February 16th and March 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S., F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	Highest (February 23rd)	30·74	Inches.
,, ,,	Lowest (March 8th)	29·16	,,
,, ,,	Mean	30·101	,,
,, ,,	,, for 23 years February	29·923	,,
,, ,,	,, ,, March	29·920	,,
Temperature	Highest (March 12th)	58·0	Deg. F.
,,	Lowest (March 2nd)	25·7	,,
,,	Mean	41·0	,,
,,	,, for 23 years February	40·9	,,
,,	,, ,, March	41·7	,,
	,, of Evaporation	38·4	,,
,,	,, ,, for 23 years February	38·7	,,
,,	,, ,, ,, ,, March	39·1	,,
(*b*) Rainfall	Amount	0·728	Inches.
,, ,,	,, Mean for 23 years February	1·687	,,
,, ,,	,, ,, ,, March	1·727	,,
,,	Number of Days on which Rain fell	12	
,,	Greatest fall in 24 Hours (March 9th)	0·158	Inches.
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·6	
,,	,, ,, for 23 years February	7·2	
,,	,, ,, ,, March	6·6	
(*c*) Wind	Velocity, Greatest (March 8th)	60	Miles.
,, ,,	,, Least (February 21st)	1	,,
,,	,, Mean Hourly	19·6	,,
,,	Greatest Pressure on Square Foot (Mar. 8, 10-25 p.m.)	29·9	Pounds.
,,	Direction at time of Greatest Pressure	W	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
79	101	85	47	110	136	68	46	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed one foot above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

THE WEATHER.

During the third week in February the barometer maintained a gradual rise, with persistent easterly winds, very little rain or sunshine, and temperature rather below the average. Slight snow fell on the 20th. The means for the week were :—Barometer 29·999 in. ; mean temperature 37·5° ; humidity 92°/₀ ; total rainfall 0·222 in. ; sunshine 4 hours 5 minutes ; wind easterly. The last week was remarkable for the high barometric pressure—on the 23rd as high as 30·754 in. ; low temperature, except on the 25th and 26th ; dense fogs on the 22nd, 23rd, and 24th ; and snow during the night of the 28th. Means :—barometer 30·558 in. ; temperature 36·79° ; humidity 90°/₀ ; rainfall 0·225 ; sunshine 11 hours 15 minutes ; wind C & N.

The month of February was characterised by low rainfall, in fact the lowest monthly record for the past two years ; for cold easterly winds ; high barometric pressure ; and less range of temperature than usual. The temperature, having seldom exceeded that of "growing-point," had a beneficial effect in holding in check a too early growth of vegetation ; on the other hand the lowest minimum has been 5° above the average. The barometer made 14 oscillations, with an extreme range of 1·142 in., and a mean pressure of 30·247 in., or about 0·25 in. above the average. The mean temperature, corrected, 37·09° was about the average, and the highest and most equable of the last four years. The maximum, 46·05°, occurred on the 1st, and the minimum, 32·28°, on the 28th. The highest maxima, 50·0°, were on the 1st and 25th, and the lowest minimum, 27·1°, on the 28th. Frost occurred on 11 nights, as against 15 last year. The earth and lake thermometers were practically the same as in 1889. Humidity about 4°/₀ above the average. Rain or snow fell on 9 days to a depth of 0·569 in. ; bright sunshine was below the average—36 hours 50 minutes, or 14°/₀ of the possible amount.

During the first four days in March the weather was cold, slight snow falling on the 2nd and 4th, with north-easterly winds ; the mean temperature of the 3rd was only 28.1°. On the 5th strong north-westerly winds commenced, blowing half a gale on the night of the 6th. Barometer unsteady and range wide. During the last three days the temperature was above the average, and the proportion of ozone exceptionally high for Bolton. The means were :—Barometer 30·069 in. ; temperature 35·55° ; humidity 80°/₀ ; rainfall 0·157 in. ; sunshine 21 hours 50 minutes ; winds variable. On the 8th and 9th the temperature was below, but during the rest of the week above the average ; slight hail fell on the 8th and 9th, and on the latter day 1½ in. of snow fell. Barometer rather unsteady and moderate range. Means :—Barometer 29·887 in. ; temperature 43·45° ; humidity 83°/₀ ; rainfall 1·225 in. ; sunshine 7 hours 20 minutes ; wind westerly.

W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, March 18, 1890.

Sheffield.

METEOROLOGICAL SUMMARY.

February, 1890.	TEMPERATURE. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for Feb.* Daily Max.	Daily Min.	RAINFALL. Total Ins.	No of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date.	Mean for Feb.* Ins.
Sheffield	51°	21st	28°	28th	38°	—	—	0·84	7	0·53	15th	—
Spurn Head.	49°	1st	30°	28th	38°	—	—	0·74	10	0·33	15th	—
York	51°	3rd	27°	24th	38°	45°	34°	0·76	8	0·45	15th	1·88
Liverpool	50°	1st	29°	28th	38°	45°	37°	0·56	9	0·15	15th	1·85
Holyhead	51°	11th	32°	13th	41°	46°	39°	1·21	10	0·41	19th	2·90
Yarmouth	46°	1st	30°	28th	38°	43°	35°	0·66	11	0·29	15th	2 02
Oxford	50°	1st	26°	13th	38°	46°	36°	0·76	9	0·37	15th	2·06
London	51°	17th	28°	28th	39°	47°	36°	1·00	7	0·54	14th	1·89

Temperature was in every case below the average, and the rainfall was very much less than the average. * The means are for 15 years.

PRESSURE.

February 16 to March 15, 1890.

On February 16th pressure was low, with a shallow depression over central England and another approaching from the west, but on the 17th these depressions had passed away, and the barometer was recovering, the readings ranging from 29·6 in. to 30·0 in. The rise continued on the next day, and on the 19th, when the barometer was between 30·0 in. and 30·5 in. ; but there was a slight fall on the 20th, though the readings were above 30·0 in. On the 21st pressure was steady and even, being between 30·0 in. and 30·1 in., and it rose to 30·4 in. all over England on the 22nd, and to 30·7 in. on the 23rd, continuing very high (30·4 in. to 30·7 in.) till the end of the month. On the 1st of March there was a decided fall, and the barometer was between 29·9 in. and 30·2 in., and it recovered again the next day, and was up to 30·5 in. on the 3rd. There was a quick fall, with a depression from the north, on the 4th, and the readings ranged from 29·7 in. to 30·4 in., and on the 5th they were between 29·7 in. and 30·1 in., with a tendency to rise. The barometer fell again on the 6th, and the isobars were close, the readings ranging from 29·4 in. to 30·0 in., and there was very little change on the

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7th, but a further fall on the 8th, when the barometer was down to 29·1 in. in the N. and 29·6 in. in the S. A steady rise commenced on the 9th, and was continued on the 10th and 11th, when readings were between 29·6 in. in the N. and 30 3 in. in the S. There was little change on the 12th, but on the 13th there was a decided fall to 29·3 in. in the N. and 30 0 in the S., the fall continuing on the 14th and 15th, when the barometer readings were 29·0 in. in the N. and 29·6 in. in the S.

THE WEATHER.

During the week ending February 22nd the weather on the whole was dry, except in the west where there were some heavy falls of rain. Temperature was rather low, and there was a good deal of cloud, but not much wind. There was rain on five days at Holyhead, three at Liverpool, two at Sheffield, York, and Oxford, one at Spurn and Yarmouth, and none at London. From February 23rd to March 1st the weather was at first fine, and temperature was about the average height, but towards the close of the week the weather became much colder and more winterly, with keen frosts and occasional snow-storms. There was rain or snow on six days at Yarmouth, five at Spurn and York, three at Liverpool, London, and Oxford, and two at Sheffield and Holyhead. In the week ending March 8th the weather was at first very cold and tolerably quiet, but afterwards it became mild and unsettled, with strong winds or gales in many parts of the Kingdom. The cold was intense on March 3rd and 4th, 17 degrees of frost being registered in London on the latter date, and 15 at Oxford. There was rain or snow on seven days at Yarmouth, six at Holyhead, four at Spurn and Liverpool, and three at Sheffield, York, Oxford, and London. During the week ending March 15th the weather became much warmer, and the rainfall varied considerably in various parts of the Kingdom, being heaviest in the west and north, and the wind was strong most of the time. No frost was experienced after the 10th. There was rain on four days at Holyhead, three at Sheffield, York, Liverpool, and Oxford, two at Yarmouth and London, and one at Spurn.

SUN SPOTS.

No spots were observed on the sun from February 16th until March 4th, many of the intervening days being too cloudy for observations. On March 4th there was a small elongated spot near the north-east limb, and on the 5th this spot had advanced on the disc and was much larger, with a smaller and fainter following spot, the whole surrounded by bright faculæ. On the 6th the larger spot was divided in two, both being surrounded by one oval penumbra, the spots being at each extremity of the major axis of the penumbra, and there was still the small following spot. On the 8th a considerable change had occurred, there being now four spots, one at each corner of a diagonally square penumbra. On the 11th the spots were approaching the western limb, and there were now only two, one of them being large and oval, with a smaller rounder spot below, or to the south of it. On the 12th there were three spots, nearly circular, one below the other, and diminishing in size from the upper or northern one, the whole accompanied by faculæ extending a considerable distance. There were also some faculæ on the other extremity, or N.N.E. limb of the sun. On the 13th the spots were still visible but apparently smaller, and very near the western limb of the sun. The faculæ on the N.N.E. side were still visible further on the disc, but without any spots near them. On the 15th the sun was spotless, and there were no faculæ.

Societies and their Work.

PREPARATIONS are now being made by many of our local scientific societies for the work of the ensuing summer season. The winter meetings are almost over.

The MANCHESTER SCIENTIFIC STUDENTS' ASSOCIATION held their usual Spring Soirée in March, at the Memorial Hall, when a large collection of interesting objects was brought together. The special address on the occasion was delivered by Professor Boyd Dawkins, the newly-elected president, who took for his subject, "Buried land of Lancashire and Cheshire."

Two communications, widely differing in character, but both of great interest, were presented to the LIVERPOOL SCIENCE STUDENTS' ASSOCIATION at their February meeting. Mr. M. L. Davies discoursed upon "Iron Pyrites and its uses," exhibiting a collection of fine specimens; and Mr. A. J. Banks explained the mysteries of the manufacture of soap, and its action in washing.

At a meeting of the NORTH OF ENGLAND MICROSCOPICAL SOCIETY, Mr. T. Swallow exhibited a large collection of slides of micro-fungi, and explained many points connected with the vegetative and reproductive processes of this class of organism. ——The MICROSCOPICAL SOCIETY OF MANCHESTER have been investigating the embryology of the chick, as illustrated by the researches of Mr. E. P. Quinn.

One of the most flourishing societies in the Kingdom engaged in promoting the study of Geography, is the MANCHESTER GEOGRAPHICAL SOCIETY. Eminent travellers and others who can speak with authority are usually invited to give addresses, or to read papers. One of the recent addresses delivered before the members was by Mr. Douglas W. Freshfield, Hon. Secretary to the Royal Geographical Society, on "Mountaineering in the Caucasus."

The question of the age of the Walls of Chester came up again at the LANCASHIRE AND CHESHIRE ANTIQUARIAN SOCIETY, when Mr. T. Cann Hughes adhered to the old, or "orthodox" view, that the disputed portions of the wall were Roman, and not Edwardian.

One of the numerous societies established in connection with the Liverpool University College, is the PHOTOGRAPHIC. Mr. Paul Lange has been describing to the members the utility of the detective camera. ——At the meeting of the AMATEUR PHOTOGRAPHERS of MANCHESTER, Mr. J. Wilcock reported the progress of the photographic survey of the district, and Mr. W. J. Chadwick read a paper on that neglected instrument, the stereoscope.

The LEEDS LITERARY AND PHILOSOPHICAL SOCIETY recently had the advantage of hearing Professor Marshall Ward, F.R.S., of the Royal Indian Engineering College, speak on "Timber," on which subject he gave much information that was interesting.

MR. C. E. MILES, who has contributed several useful papers on mineralogical subjects, read one before the TRANMERE LITERARY SOCIETY on "Quartz."

The Liverpool section of the SOCIETY OF CHEMICAL INDUSTRY were provided with an excellent paper by Mr. T. S. Rigby, on "A new process for the manufacture of Portland Cement."

It is not often thought that the vicinity of the Liverpool docks would afford much prospect of botanising; but Mr. Robert Brown gave to the NATURALISTS' FIELD CLUB of that seaport, some interesting details of foreign plants obtained near the Birkenhead and Garston docks, which were supposed to have been introduced in ships' ballast, corn, &c. At another meeting of the same club, Mr. Edward Davies, F.C.S., lectured on "Some colouring matters obtained from lichens."

Before the LEEDS NATURALISTS' CLUB, Prof. L. C. Miall, F.G.S., gave an elaborate paper on "The development of the fly of Chironomus," an insect which belongs to the order of the diptera. At one of the "practical" meetings of this Club, Professor De Burgh Birch entered into the preparation of brain tissue for section-cutting, so essential in the study of its minute structure.

A report of the "Scottish Land and Freshwater Mollusca," was submitted by Mr. W. Denison Roebuck, F.L.S., late of Leeds, to the ROYAL PHYSICAL SOCIETY OF EDINBURGH, the object of which was to enlist the co-operation of naturalists in the work of the Conchological Society of Great Britain.

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At the March meeting of the LIVERPOOL GEOLOGICAL SOCIETY, Mr. W. Semmons read a paper describing a recent visit to the cupriferous sandstone district of Navarre, in the north-east of Spain. The meeting of the GEOLOGICAL ASSOCIATION of that city was devoted to a paper by Mr. D. Clague, F.G.S., entitled "Notes on Summer Rambles in the Liverpool Districts."

MR. I. C. THOMSON gave his paper on the "Development of Crustacea" before the Chester Society of Natural Science (*Zoological Section*). The following meetings of this society have also been held:—*Paxton Society*—"Injurious Insects," by Mr. R. Newstead; "The shape, colour, and perfume of flowers," by Mr. J. D. Liddall. *Literature Section*—"Dictionaries," by Dr. T. N. Brushfield; "The Chester Mystery Plays," by Mr. Henry Sandford. *Photographic Section*—"Land of the Midnight Sun," by Mr. G. F. Wynne. *Botanical Section*—"Spring Flowers," by Mr. Leo. H. Grindon.

We shall be glad if Secretaries of Societies will send us early intimation of their arrangements for Excursions and other meetings during the summer months.

Reports of Societies.

Archæology.

CHESTER ARCHÆOLOGICAL AND HISTORIC SOCIETY.—At the fourth sessional meeting a paper was read by Mr. J. Hargreaves on "The Hundred of Wirral," illustrated by about 200 limelight views, taken for the purposes of the photographic survey of that division of Cheshire, exhibited by Mr. Paul Lange. Mr. Hargreaves gave an interesting account of the antiquities of Wirral and of its places of picturesque or historic interest. He said that:—

Three-fourths of the Wirral boundary is daily washed by the tide, and, more abundantly in former times even than now, it has, therefore, been well furnished with fish. Although it has no high mountains, the neighbouring Snowdon range forms a noble background for countless landscapes. It has no internal lakes or deep rivers, yet the estuaries of the Mersey and the Dee furnish a variety of pictures difficult to excel. There remains still unenclosed a large extent of wild, heather-covered moor, and it also abounds in pretty streams winding along well-wooded valleys. Flowers, especially roses, grow luxuriantly here, also many kinds of fruit. Up to the beginning of this century it must have changed but little either in the number or character of its population for hundreds of years; and even yet some of the interior villages have few, if any, more inhabitants than in the reign of Elizabeth. Outside Birkenhead, it has, so far, not suffered from the innovation of manufacturers. All over its area are dotted ancient churches, whose churchyards are made sacred by the dust of many generations. And, whilst we have no ancient palatial castles of the titled aristocracy now left to us, we have a profusion of beautiful homes, ancient and modern. Following the ancient British and Roman periods we have a complete Saxon occupation. Whether from its proximity to the warlike tribes of North Wales, or from the influence of the Roman soldiers, whose twentieth Legion had its headquarters at Chester, until the evacuation about 400 A.D., Cheshire has always been a notably military county. Henry II. gathered together his forces at Shotwick Castle for the first great expedition to conquer Ireland. Many other relays of soldiers and rulers were despatched in successive reigns, also during the Commonwealth; and, lastly, the memorable army led by the "glorious, pious, and immortal William," who embarked at Parkgate or Dawpool in 1688. Although in the Monastic period nearly the whole of Wirral was spiritually subject to the Abbey of St. Werburgh and the Priory of Birkenhead, after the dissolution of religious houses by Henry VIII., the Reformed faith appears to have got a firm hold of its people. Much might be said of the innate fondness of its people for sports and games. Bull-baiting and cock-fighting were indulged in even down to the end of George the Third's reign. Horse-racing at Wallasey was largely patronised, when the Earls of Derby lived at Bidston, in the Stuart period. Many games of skill and rude strength were practised at old-fashioned merry-makings in the hundred in the "good old times." The celebrated J. M. W. Turner, the great painter, so far discerned the artistic beauties of the district that he studied at Wallasey some of his great works now in the National Gallery. And, in these later days, it appears to have inevitably fallen to the lot of Wirral photographic artists to inaugurate the first systematic complete "Photo-historic survey." The success of this survey is largely due to the discovery by Mr. Benjamin J. Sayce, of Rock Ferry, of the "collodio-bromide" process. The total number of pictures taken during the past two years under this scheme exceeds four hundred; and as many more might be taken without exhausting the subject.

Biology and Natural History.

LIVERPOOL BIOLOGICAL SOCIETY.—At the meeting of this society held on the 14th March, Mr. A. W. Bennett, M.A., B.Sc., F.L.S. (Lecturer in Botany in St. Thomas's Hospital Medical School, London), read an address on "Reproduction among the lower forms of vegetable life." Mr. Bennett who is a specialist in the fresh water *algæ*, gave a *résumé* of the latest views respecting these forms in particular, passing into review, illustrating with diagrams and microscopical preparations, the several stages from the simplest, where two similar masses of protoplasm coalesce, to the more complicated form where the male and female protoplasmic elements are completely differentiated. Following on the lines of the nomenclature of his recent work on Cryptogamic Botany, Mr. Bennett used Anglicized terminology mainly throughout his address. To the student who has followed the classical terminology this was rather a disadvantage than otherwise, especially in the use of the term "flagel" instead of "*cilium*" as applied to the primitive organs of motion and locomotion in lowly forms of life. He emphasized he opinion that the study of the phenomena of life in these lower forms is of supreme importance to the student of biology, to the true understanding of the theory of evolution.

SHEFFIELD NATURALISTS' CLUB.—In a lecture given at a recent meeting, entitled "Natural History Notes on the Yacht 'Glimpse,' in 1889," Dr. Sorby chiefly confined his remarks to such animals as he could show on the screen, prepared as lantern slides; and devoted a considerable part of the lecture to a description of the manner in which such slides can be prepared. He hopes to greatly extend and improve the method during this year's cruise, and looks upon what has been done merely as a commencement. Though the details must vary according to the character of the animals, yet it may be said that on the whole the method consists in drying them on glass, and in some cases in subsequently mounting them in Canada balsam. As an illustration, some cases may be described. Taking such a beautiful Nudibranch as Eolis, it may be first washed in a mixture of equal parts of alcohol and water, then properly arranged on the glass, and allowed to dry. Success depends to a great extent on the fact that the edges dry first, and adhere to the glass in such a manner that the subsequent drying reduces only the thickness of the object; and, when dry the original outline is perfect, and the animal seems as it were a projection on the plane of the glass. When subsequently mounted in balsam and used as a lantern slide, the natural form and colour are seen on the screen like a beautiful picture. Such Chatopoda as Niveis are easily prepared, and when thrown on the screen not only the general form but every hair and the chief blood vessels are visible, though some of the latter are too small to be well seen unless the real object is examined with a low magnifying power as a hand specimen. Strange to say such very unpromising animals as Medusa give most satisfactory results. They must first be deposited for a considerable time in diluted alcohol, to remove the salt, then strained with Keinberg's Hamatoxolin or Beale's Carmine and finally dried on glass and mounted in balsam. When thrown on the screen the most important points in their structure are well seen. The fringe of tentacles and the sub-umbrella stain dark, whilst the canal system is beautifully shown dark on a pale back-ground. In fact it would be difficult to artificially paint a diagram shewing the structure better than does the real animal thus prepared. Such preparations as those named above are equally satisfactory as muesum or cabinet specimens since they take up much less room than bottles, do not lose their colour, and can be so easily examined in the hand with low magnifying power.

LIVERPOOL NATURALISTS' FIELD CLUB.—On February 27th, Mr. Edward Davies, F.C.S., F.I.C., gave a lecture on "Some colouring matters obtained from Lichens." The fact that brilliant colours could be obtained from some lichens, although they were of grey or

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whitish colour, was shewn to be due to the colouring matter being derived from a colourless substance, "orcin." This, under the influence of ammonia and oxygen, gave "orcein," a brilliant purple-red body. The lichens whiah contain orcin are principally rock growers, and of the genera *Rocella* and *Lecanora*. To test lichens for their dyeing power they are digested for some days with ammonia, allowing excess of air. The solution is then freed from ammonia and the dye is ready for use. Some lichens gave red or purple, others grey, brown, or yellow. Commercially the liquid extract was known as Archil, the dried powder as Cudbear, and an alkaline extract, mixed with much gypsum, as Litmus. The solution of the last named was used, when neutralised, to distinguish acids and alkalies. The former turn it red and the latter blue. The lecture was illustrated by a number of experiments and a collection of lichens, and was extremely interesting.

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Microscopy.

EALING MICROSCOPICAL AND NATURAL HISTORY SOCIETY.—The annual meeting of this society was held on the 22nd February, the Rev. Percy Myles, B.A., F.L.S., vice-president, in the chair. The committee, in presenting the 13th annual report, which was read by the Hon. Secretary (Mr. A. Belt), stated that they again had the gratification of recording a steady improvement in the affairs of the society. The numbers continued to increase, with the result that, notwithstanding that during the year no less than 11 members had been lost owing to their removal from the neighbourhood, the total number at present on the list was 151, compared with 142 at the last annual meeting. The treasurer's accounts showed a balance in favour of the society of £37 os. 11d. The meetings had generally been well attended. It had been the aim of the committee to obtain lectures on as varied subjects as possible, so that the diversity of tastes among members might be gratified. The following was the list of lectures delivered during the year:—Spring Session: Feb. 23, "A century of progress in floriculture," by the President, Rev. Prof. Henslow, M.A., F.L.S., F.G.S. March 9, "The migrations of birds," by Mr. H. Seebohm F.Z.S. March 30, "The economy of the beehive," by Mr. W. H. Harris, B.A., B.Sc., and "Honeydew," by Mr. G. Henderson. April 13, "The study of zoology," by Mr. F. E. Beddard, M.A., F.Z.S.. F.R.S.E. April 27, "Mosses," by the Rev. P. W. Myles, B.A., F.L.S. May 11, "Insects injurious to vegetation," by Mr. W. F. Kirby, F.E.S. May 25, "Some rotifers from Ealing ponds," by Mr. R. T. Lewis, F.R.M.S. Winter Session: October 26, "On preparing and mounting microscopical objects," November 16th, "Hybrid rhododendrons," by the President. November 30, "Foraminifera." December 14, "The first electrician," by Mr. B. W. Richardson, M.D., LL.D., F.R.S. January 11, 1890, "The nervous system," by Mr. F. Robertson Haward, M.R.C.S. January 25, "Spiders," by Mr. W. T. Davy. February 8, "Some problems connected with the coloration of animals," by Mr. F. E. Beddard, M.A., F.Z.S., F.R.S.E. During the year, the report added, an attempt had been put forth to bring the society more into touch with the kindred associations existing in the neighbourhood. With this end in view, a reciprocal arrangement had been made, by which the members of the Ealing Society obtained the privilege of being present at the lectures of the neighbouring societies, whose members, on the other hand, had the opportunity of attending the meetings of the Ealing society. The excursions had included visits to the Royal Botanic Gardens, Regent's Park, to Burnham Beeches, and to Windsor, Eaton and Datchet. The annual conversazione, held in November, was attended by over 400 members and friends. During the year death had deprived the society of an old and valued member, Mr. George Henderson, who in many unobtrusive ways rendered it assistance. The appeal made in the last report for further donations of books had been liberally responded to by officers of the society and others, foremost being the President, who had presented over 50 volumes. Another valuable addition was a set of large diagrams illustrating insect ravages, contributed by the Science and Art Department. Mr. C. N. Peal, F.L.S., the hon. treasurer, gave the financial statement, which showed that, after meeting expenditure, a balance of £37 os. 11d. remained in hand at the close of the year. The report of the Fauna and Flora Sub-Committee was next presented. The committee stated that they received only slight assistance from the general body of members; hence the work of obtaining full and accurate information on the species of animals and plants found in the neighbourhood, and their comparative scarcity or abundance, made only slow progress. Numbers of interesting observations were probably lost on account of the observers not thinking them of sufficient importance to communicate; but it should be remembered that an apparently trifling fact might be just what was wanted to complete some line of investigation. Some further details had been obtained concerning pond-life, lepidoptera, mollusca, and plants, and it was hoped that next year the committee might be in a position to publish some notes on one or more of those subjects. The botany competition had not proved as successful as it did the previous year. Twenty-three competitors sent in their names, but only a few persevered with the course. The principals of the schools appeared to have lost interest in the subject, and as, without their hearty co-operation, it was impossible for the society to assist in cultivating in their pupils a love and knowledge of botany, it was not proposed to continue the competition during the present year, though if at any future time the desire for some such scheme should revive, the committee would be glad to do everything they could to foster it. The report next alluded to an entomological competition offered to boys—for the best collection of insects injurious to plant-life. This competition, however, received but little attention, only one competitor sending in a collection. The election of officers and committee was then proceeded with, resulting as follows: President, Rev. G. Henslow, M.A., F.L.S., F.G.S.; vice-presidents, Major-Gen. Collinson, R.E., and Rev. P. W. Myles, B.A., F.L.S.; hon. treasurer, Mr. C. N. Peal, F.L.S.; hon. curator and librarian, Mr. F. L. Lambert; hon. secretary, Mr. A. Belt. The Chairman then made some observations on the causes which had contributed to the flourishing condition in which the society found itself. He remarked that everything in connection with the society appeared to be as satisfactory as it could possibly be, and in certain matters the society was in a more prosperous state than it had ever been before. The library had become an absolute reality, and he looked forward to the time when the members would make still further use of it. As regarded the printing of the reports, he thought the proceedings of that society would bear favourable comparison with those of many other and more ambitious societies. Mr. Myles said that he attached considerable importance to the social gatherings and excursions held in connection with the society, and, referring to the lectures, remarked that in regard to them the society were greatly indebted to outside lecturers, though they had not been dependent upon them, but had had various highly interesting and important lectures delivered to them, and facts brought before them, from amongst their own members. The president then delivered an able address on the advantages to be derived from visits to the South Kensington Natural History Museums, in the pursuit of a competent knowledge of natural history subjects, of which we hope to give some extracts in our next issue.

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BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—On Feb. 24th, Mr. H. Hawkes showed under the microscope peristimes of *Polytrichum undulatum*. Mr. G. H. Corbett, pebbles containing parts of Trilobites, &c., from the Bunter beds. A paper was read by Mr. J. W. Dunn on "Volcanoes." The writer referred to the ancient traditions and superstitions concerning volcanoes, and said they were generally regarded from a destructive point of view, but they had also a beneficial side. The phenomena of volcanic action was described, and the

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theory of absorption by incandescent rock masses enlarged upon. The fact of volcanoes nearly always occupying rising areas proved their use as elevation forces. Mr. J. Collins exhibited a collection of dried plants belonging to the natural order *Leguminasæ* and *Rosaceæ*; Mr J. Rodgers, slab of shale with impressions of *Lepidostrobus*; Mr. Round, scales of ganoid fish from the coal measures. On March 10th, Mr. H. Hawkes, an abnormal growth of daffodil, the *corolla* and *perianth* being on one side; Mr. Cracroft, m dified quar z from the Crystal Mountains, America. Mr. T. H. Waller, B.A., B.Sc., then gave a lecture on "The Story of a Pebble." The lecturer said that if a gravel pit in Sutton Park were visited the stones when touched with the hammer would be found very friable. The cracks all start from the point where they touch some other stone, and are vertical. Some local and exceptional cause brought this about, possibly local faulting. Among the stones are some cavities containing casts of stalks of *Encrinites* showing that pebbles of mountain limestone had been dissolved by the action of rain water; and there are also pebbles of quartz, porphyry, tourmaline, perhaps a few of granite, though these are rare. They all give evidence of rapid water action, and were possibly brought by a great river from the north. Such deposits are now being formed in the Himalayan district of India. The lecturer described the mountains from which these fragments were possibly torn, ground down to sand and cemented together again by a solution of silica, and concluded by speculating on the future of our island whether it would be elevated so as to join the continent again or depressed until the mountain tops alone are visible. On March 17th Mr. H. Hawkes exhibited a collection of British ferns, also one made by Dr. Arnold about 50 years ago, containing some specimens now extinct. Other specimens were exhibited by members.

Entomology.

Lancashire and Cheshire Entomological Society.—At the monthly meeting of this society, held on March 10th, the president (Mr. S. J. Capper, F L.S.,) contributed some notes on the variation of lepidoptera, which elicited an interesting discussion on the melanism of several local species, illustrating his remark by some beautiful varieties of *Vanessa Urticæ* from his collection, some of which are figured in Newman's "British Butterflies," and some in Mosley's "Varieties." Mr. C. H. H. Walker gave a brief comparative sketch of the generative systems, as exemplified in the order *Insecta*, in which his skilful drawings on the black board greatly assisted those present in obtaining a clearer conception of the structure and function of these complicated organs. Mr. W. Lindlaw exhibited a large specimen of *Sphinx convolvuli* captured last autumn at Oxton.

Geology.

Geological Society of London.—The anniversary meeting was held on February 21, when the secretary read the report of the Council for the year 1889. The annual presentation of medals took place, being awarded as under:—The Wollaston medal to Professor W. Crawford Williamson, in recognition of his services in palæontology, and in elucidating the structure of plants; the Murchison medal to Professor E. Hull, for geological research in connection with the Geological Survey of Great Britain and Ireland; the Lyell medal to Professor T. Rupert Jones. The balance of the Wollaston fund was presented to Mr. W. A. E. Ussher; that of the Murchison fund to Mr. E. Wethered; that of the Lyell fund to Mr. C. D. Sherborn; and the proceeds of the Barlow-Jameson fund to Mr. W. Jerome Harrison. The anniversary address was read by the president, Dr. W. T. Blanford, who, after giving the usual obituary notices of Fellows and others, dealt with the subject of the permanence of continents and ocean-basins. After reviewing the evidence derived from the rocks of oceanic islands, and the absence of deep-sea deposits in continental strata of various ages, he proceeded to consider the geographical distribution of animals and plants, and gave reason for believing that Sclater's zoological regions, founded on passerine birds, were inapplicable to other groups of animals or plants, and that any evidence of continental permanence based on such regions was worthless. Elevations and depressions exceeding 1,000 fathoms had taken place in Tertiary times, and, from a consideration of the biological and geological facts in support of a former union between several lands now isolated—especially between Africa and India, *via* Madagascar, and between Africa and South America—the president did not consider that the theory of the permanence of ocean-basins, though probable, was proved, or was tenable to the extent to which it was accepted by some authors.——At the meeting on 26th February a paper was read by Professor J. Prestwich, F.R.S., on "The relation of the Westleton Beds or 'Pebbly Sands' of Suffolk to those of Norfolk, and on their extention inland," with some observations on the period of the final elevation and denudation of the Weald and the Thames Valley. —Part III., "On a Southern drift in the Valley of the Thames." In this, the third part of his paper, the author described the characters of the southern drift and its mode of occurrence, and entered into an enquiry as to the early physiography of the Wealden area. The Westleton Beds were referred to a period subsequent to that of the formation of the southern drift.

Liverpool Geological Association.—On February 8th Mr. James Hornell delivered an address to members at the Museum, William Brown Street, on "Marine Worms," his remarks being illustrated by the excellent specimens and morphological diagram contained in the cases there. Having briefly sketched the broader aspects of worm structure, the lecturer said that the portion of the class of special interest to geologists is the Polychætons division of the marine worms—characterised by distinct segmentation of the body, and by the possession of locomotive appendages (or "feet") which are armed with bundles of delicate bristles or setæ. Definite characterisation is, however, extremely difficult, so complex and varied are the modifications of all organs. The division, as a whole, is split up into two groups—the less modified and more typical one comprising those worms with well-developed feet, and of wandering and predatory habits, living chiefly on small animals—sponges, hydrozoa and crustaceans—and seaweeds. Such feeding favouring the development of hard biting parts, we find many of these worms with extremely strong chitinous jaws, and these, together with some trails on what was once mud, are practically the sole records of their past being found in the geological record. Undoubted jaws of this description have been found in Palæozic rocks. The problematical bodies called conodonts abounding in certain Cambrian rocks, are also believed by some of our highest authorities to represent the same structures, but so far, this view is not of universal acceptance, as while they resemble nothing so much as annelid jaws, yet we know of no living annelid having jaws, even approaching the complication to be seen in conodonts. The other group of the polychætons worms comprises those which either live in burrows in sand and mud, or in protecting tubes, self-constructed. The respiratory apparatus assumes a highly specialized form, frequently as a plume of delicate filaments surrounding the mouth—these branchiæ being capable of retraction within the tube at will. The feet, so characteristic of the errant worms, tend to atrophy among these tube-dwellers. Certain of this group form very strong, wear-resisting tubes by calcareous secretion from their bodies. These little shells are often found attached to the valves of mollusca, and in that position are found in a fossil state. Of the commoner forms are serpula, spirorbis, and ditrupa. Others, as pectinaria, build around their bodies very regular and graceful tubes with grains of sand, just as we have seen under the microscope the lovely little Rotifer *Melicerta* add brick after brick to its tiny dwelling. Many again produce tubes of a parchment-like character, in which are incorporated or agglutinated particles of mud, sand, or shell fragments.

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sabella, sabellaria, and terebella are familiar and beautiful instances of these homes without hands. Mr. Isaac E. George, who followed with a few notes as to the geological importance of the annelids, remarked that in some of the most ancient British rocks the only fossil evidences remaining were those associated with the existence of marine worms. In the hard quartzites of the stiper-stones, for instances, the burrows of worms, together with sun-cracks and rain-pits, shewed that we had to deal with shore deposits. The sandstones of the coal measures and Wealden series also frequently abound in the burrows, castings, and tracks of annelids. He had observed that whilst the fossil burrows were usually associated with tolerably white sandstones, the annelids of the present day were commonly found to burrow in very dark-coloured, muddy sands. This might be accounted for on the supposition that by repeated passage through the alimentary canal of the worms, the carbonaceous matter associated with mud might in course of time be almost removed, and a band of whitish sand remain as a purified product. In this respect, marine worms probably acted like the earth-worm in keeping a certain thickness of their plastic environment in continual circulation. Any seam of sand which marine worms had gradually and finally deserted in favour of new material accumulated at a higher level, we should expect to find freer from carbon, and therefore whiter than the later deposits. The subject was certainly deserving of careful investigation and comparison.

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MANCHESTER GEOLOGICAL SOCIETY.—On the 11th March, Prof. W. Boyd Dawkins, F.R.S., read a paper on the "Discovery of Coal Measures near Dover." He said that his communication must be looked upon as wholly preliminary, and as merely the first sketch of an unfinished work. From the year 1886 the work of boring had been going on under very considerable difficulties, and it would never have been carried to its present success had it not been for the indomitable energy of Sir Edward Watkin. The boring started at the foot of the Shakspere Cliff, close to the Channel Tunnel Works, and the coal measures were reached at a depth 1,204 feet from the surface of the ground. The boring was still going on, but the account of what was met with down below could not be published until the exploration had been completed. The coal was a distinctly bright, blazing coal, very much like that which was found in the collieries in the Mendip Hills. There was no doubt that the coal measures found in this section were a continuation of the coal measures at Calais. The coal was found in a long narrow belt exactly of the same order as the long narrow belt of coal which was of such enormous value to Belgium and northern France. In estimating the value of this new coalfield, he found considerable aid in Mr. Prestwich's evidence given before the Coal Commission. Mr. Prestwich declared that the Belgium coal measures and the North French coal measures were 9,400 feet in thickness and contained 110 seams of coal capable of being worked. In the Dover coalfields the measures were broken and smashed, so that in going down a vertical shaft the same measure might be crossed three times. He did not venture to anticipate what might be the result of their further boring, but he did say that the result of this boring was of scientific and commercial value, not merely because there was a probability of its revealing the existence of a most valuable coalfield in that spot (which was comparatively a small point), but because it showed where there was a definite base line, so to speak, for further explorations; and, speaking of further explorations, he would like to say that borings of this kind, carried on under the fostering care of the French Government, had turned two plain agricultural departments of Northern France into great centres of industry, and it seemed to him to be by no means improbable that in the course of a few years borings would be carried out in this country, which would have practically the same result. He looked forward to the time when the chalk downs, which were now chiefly famous for the mutton produced on them, would be equally famous for the amount of coal they produced; and when the hop gardens, which now gave a precarious existence to a few farmers and labourers, would be the centre of a great industry. Unfortunately, we, in this country, were in a much worse position with regard to explorations of this kind than were the people of France, and the result of any philanthropic enterprise in the way of putting down a boring hole was that the explorer would have to pay the cost, while if the experiment was successful the neighbouring landowners would avail themselves of the discovery, and the man who sank the boring hole would not get a single penny. It seemed to him that this was a very unfortunate condition of things, and that there really ought to be some change in the law. If the coal-producing area in the South of England was to be properly explored some definite arrangement must be made as to who was going to do it and who was to pay for it. This enterprise in which he was engaged was to be looked upon mainly as a scientific enterprise, although it might turn out to be a commercial success. It seemed to him that the question was quite worth the attention of Parliament, and that some arrangment might be devised by which the rights of the explorer would be preserved, while at the same time the rights of the landowner would be protected. He did not anticipate that this discovery would at all affect the price of coal in Lancashire, but he believed that it would develope a new industry in the South of England. In ancient times the dreary tracts of land in Sussex and Kent, which were now inhabited by rustics, were the site of great iron mines and forges, and the country was covered with great ash heaps, similar to those now seen in the the black country. It would be a curious return to the state of things that existed in the days of Elizabeth if, in the days of Victoria, this agricultural district, through the discovery of coal, should again become a manufacturing centre, a coal-producing centre, and also probably a centre for the manufacture of iron.

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LEEDS GEOLOGICAL ASSOCIATION.—A paper, entitled "A Geological Tour through Durham into Cumberland," was given at the February meeting of this association by Mr. William Cheetham, Vice-president of the association. The chair was occupied by the President (Mr. J. E. Bedford, F.G.S.) The paper was well illustrated by diagrams, views, and specimens. Horsforth, the residence of Mr. Cheetham, was the starting point, and, as the distance from this point to the city of Durham is rather over eighty miles, there was plenty of variety. "With a good horse," said Mr. Cheetham, "the distance could be covered in a couple of days, but the whole of the tour extends to a few hundreds of miles; and we therefore considered it best to let 'Donald' have an easy time at the beginning, so we leisurely crossed Carr Bridge, through Mosley Wood, on to Bramhope, and down Creskeld Lane into Wharfedale, going down the dale to Rawden Hill, where we stayed the first night." The following is a short abstract of the paper, which was a lengthy one, and embraced a wide field of interest:—

The commanding aspect of Rawden Hill is due to its geological anatomy. It is an outlier of the third grits, standing out prominently, and isolated almost into the middle of the valley. The view is certainly one of the finest, if not the most magnificent, in the dale. The highest ridge of the fine escarpment of Almes Cragfaces the west, and the summit is formed of a rough grit that hardens with exposure. Underneath it the layer of stone is of a softer character, which succumbs readily to atmospheric denudation, and so has furnished the fierce westerly winds with a supply of fine sand to form the sandblast that has carved the underside of the summit into what looks like an ornamental balustrade. The next stopping-place was Knaresborough. It was just a year since our association had that splendid excursion to Knaresborough and Plompton, under the leadership of Mr. Holgate, and it was delightful to recall that interesting geological picture. Leaving Knaresborough, the district of the York and Ainsty Hunt is entered upon, and we are fairly upon the Permian formation. There may not at first sight appear much in common betwixt hunting and geology, but the generally-level character of the Permians furnishes some of the best hunting grounds in the kingdom, and amongst the first must be classed the York and Ainsty. The Great North Road is by no means a dead level; were the slight covering of soil removed, we should see that we

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were crossing long sandy hollows with ridges of shingle beds from half a mile to a mile apart, with just one farm-house on the summit of each ridge. The road-metal is procured from the gravel beds all along the route, and in some places rather considerable excavations have been made, which afford good opportunities for the hammer. Scotch Corner is a splendid point from which to take a general survey. A whole paper would be required to give an account of the geological formations that surround it; but this strategic part of the military Roman road of Watling Street must have some notice. Some seventeen hundred years ago, when it was constructed, the local roads connecting the towns east and west of it were the lines of district traffic, as they have remained to the present day. Another branch about fifty miles from here goes right over the shoulder of Cross Fell, a wild and desolate district, and is considered to be the finest constructed Roman road in the kingdom. It is yet known there by its original poetic name of the "Maiden Way." About seven miles further north we entered Durham at Pierce Bridge, on the Tees, deep down in the magnesian limestone. On the north side of the river there are the remains of a Roman encampment, and the raised ground about it is yet known as the Roman Ridge. Stanhope is a picturesque ancient town, once the residence of Thomas Sopwith, F.R.S., who was the constructor of the artistic geological models which were exhibited five years ago. He also published several accounts of the lead mining districts of Alston, Weardale, and Tindale. Some specimens from the sandstone on the hill top are beautifully marked with what look like impressions of heather, which Mr. Powell seemed to suppose had some connection with them, as it grows on the top of the hill. However, comparison with specimens of the Marsden Rock, near Sunderland (magnesian limestone), noted for similar but finer markings, shows them to have been produced by the same action—viz., infiltration. The great limestone dips from the Pennine range to the north-east at the rate of about 60ft. per mile, and is usually about 72ft. in thickness. Some 20,000 tons a week are quarried and sent away (to be used as a flux in smelting the iron ores of Durham and Cleveland) from the various quarries of Stanhope and Prosterley. It is divided into a number of layers (usually denominated posts), each having in the quarrymen's geology a distinctive name. Thus, on the top are the "Five Posts," then "Toby Giles," next the "Crabby," then the prettily-spotted layer called "Rosemary" or "Pea Post," next is "Elsy," and then come the "Thin" and "Thick" Cockle Posts, which, with the "Dunket," furnish the Stanhope and Prosterley marbles; next are the "Twee Toms," the "Black Bed," and the "Five Thin Posts;" next the "Dunket Post," the "Dunket Bastard," and "Dun Jinn." Below these comes a rock hard to work, known as "Stiff Dick," followed by "Whaley," also a tough customer; and finally the four layers termed the "Yard," "Jack," "Newcastle," and "Bottom Posts." The atmosphere of Upper Weardale is very pure, and the district has of late years been much frequented as a health resort. The little Whin Sill is 20ft. thick at the Briggen Winch. Lebour's "Geological Outlines of Durham" clearly shows it to be an intrusive igneous rock, and, as far as regards the Whin Sill itself, it is no longer an open question. In Weardale, as in our north-west Yorkshire limestone district, waterfalls, cascades, and caverns abound. In Heather Burn Cave, near the red vein numerous relics were found; the human remains have been described by Professor Huxley; but this cave, as well as the one at Bolihope, has disappeared. Iron ore is extensively worked, nearly one hundred thousand tons being raised annually. Lead and iron mines have been worked in Western Durham from time immemorial, but their great development only took place after the opening of the Stanhope and Tyne railway in 1834. The end of our journey brought us to Cowshill, which is very conveniently situated for geological workers, near the Burtreeford Dyke, which is said to afford the best geological section in the county of Durham. It runs from the Yorkshire side of the Tees across Weardale to Allenheads, with an upthrow to the west of 500 feet in some places. Here it has burst through the great limestone; and just below the Dyke the Cockle Post can be observed in the bed of the stream, dipping to the east at an angle of about 18 degrees, whilst west of the Dyke the beds in the stream show nearly level, or have a slight dip to the west. The return journey was made *viâ* Teesdale and Barrow Castle, then crossing almost due south to Wensleydale, Bolton Abbey, Ilkley, and home to Horsforth, the tour having occupied a fortnight, spent in the open air amid grand scenery.

General Science.

UNIVERSITY COLLEGE OF NORTH WALES, BANGOR, SCIENTIFIC SOCIETY.—The last meeting of the above for the spring term was held on March 15th, in the chemistry lecture theatre of the college. Dr. M'Gowan, F.R.S.E. (demonstrator in chemistry), read a paper on "The Manufacture of Oxygen on the Large Scale, and its Possible Technical Applications." The president, Mr. J. R. Foster, occupied the chair, and communications were read by Mr. D. M. Lewis, M.A. (demonstrator in physics), and Mr. D. O. Sydney Davies. The following papers have already been read before the society this session:—"On the Electro-magnetic Theory of Light," by the hon. president, Professor Gray, M.A., F.R.S.E.; "The Schwendenerian Theory of Lichens," by Miss Clarke; "Animal Colour and Mimicry," by Mr. Philip White, M.B. (lecturer on zoology and physiology); "Plant Distribution," by Mr. B. A. Richmond.

Reviews.

THE "PRACTICAL NATURALIST" HANDBOOKS. [London: E. W. Allen. Birmingham: The Naturalists' Publishing Company.]

THIS series of handbooks is well adapted to the needs of enthusiastic young collectors of natural history objects. The works give in a concise, yet readable form, practical hints on the collection and preservation of birds, their eggs and nests; dragon-flies; the fresh-water algæ; land and fresh-water shells; and flowering plants and ferns, each of the above subjects being treated in a separate pamphlet. They are well written and issued at a trifling cost. The same publishers also send us specimens of label-lists for collectors, comprising lists of birds' eggs (in suitable type), British star-fish, sea-urchins and sea-cucumbers, dragon-flies, stalk-eyed crustaceans, British land and fresh-water shells, and butterflies. These will doubtless be a useful assistance in attaching names to specimens.

THE MARINE TRANSPORT OF PETROLEUM.*—A generation ago the Indians of North America were accustomed to anoint their bodies with the dark shiny oil, which was found floating on the creeks in Pennsylvania. This wonderful product was then unknown to science further than that it was a good remedy for rheumatism, &c. Within a few years this dark-coloured, evil-smelling oil has been the means of enabling millions of people to obtain a living in sinking wells, distilling, and purifying the crude petroleum or rock oil. Thousands of ships, both sail and steam, are employed in carrying it to the ends of the earth. Thousands of households rely upon petroleum as their means of lighting. In all the great engineering works petroleum is used as fuel, and also to illuminate large spaces. It is used as a motor instead of steam. No boiler is required. It is not too much to say that there is no industry but what uses petroleum in one form or another. Do we wish to make an old coat look like new?—we use benzine. Are our hands chapped?—we use vaseline. Is our waterproof coat torn?—we repair it with naphtha solution of indiarubber. Has an old-fashioned lady a weakness for wax candles?—she uses ozokerit. Does the telegraph department of the post office require a good insulator?—it uses paraffin wax. In cotton mills, the lubricating oil is petroleum, in one of its many forms. In short, there is hardly any substance so useful and with so many applications During the last few years such has been the demand that petroleum is transported in bulk in specially-constructed tank steamers. It is this branch of the subject that has engaged Mr. Little's attention. In his book he describes petroleum and its transport from the wells to the consumer's lamp. Every information is given to enable the trade to be carried on with safety. Mr. Little fully explains the causes which produce fires and explosions, and to those shipowners and captains employed in the trade they will find many points explained. While Mr. Little has written from a practical point of view, he also gives scientific demonstrations of the stability of petroleum-carrying vessels, as it is hardly necessary to say that a steamer carrying a liquid in bulk requires very careful handling. Looking at the vast dimensions of the trade and its growing importance, the book is of great value, and the author is to be congratulated on its production. The work is profusely illustrated. The binding and get-up are excellent, and do credit to the publisher.

Journal of the Liverpool Polytechnic Society. 1889-90.—The papers printed in this volume show the steady progress of the society, which now numbers 115 ordinary members on its roll. All the subjects treated are of the thoroughly practical order, and will repay perusal. Among the most

* *The Marine Transport of Petroleum* for the use of shipowners, shipbuilders, underwriters, merchants, captains, and officers, and all engaged in the trade, by Mr. GEO. H. LITTLE, editor of the "Liverpool Journal of Commerce." Published by Messrs. E. and F. N. Spon, 125, Strand, London, and 12, Cortland Street, New York, U.S.A. Price 10/6.

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notable may be mentioned the presidential address by Mr. J. Armstrong, on "The History of the Iron and Steel Manufacture," and papers by Mr. T. Morris, F.G.S., on "Basic Slag and its Utility as a Fertilizer;" by Mr. J. Simmance, on "Ventilation by Gas;" by Mr. H. B. Thwaite, C.E., on "Crude Hydrocarbon Liquids as Heating and Lighting Agents;" by Mr. G. F. Ransome, on "Hydraulic Buffer Stops;" and Dr. Geo. Tate, on "Estimating Minute Weights of Gold." Following the practice of some other societies, the discussions which take place at the meetings are fully reported in the *Journal*.

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Journal of the Liverpool Astronomical Society. Edited by Herbert Sadler, F.R.A.S. December, 1889.

A PAPER by Mr. S. E. Peal on "Lunar Cones of Eruptions," another on "Stellar Evolutions," by Mr. M. Fergus, together with a report of the Coloured Star Section, and the usual Notes and Correspondence, comprise all that the present part of the L. A. S. *Journal* contains. A circular letter to the members states that the lamented death of the late president, the Rev. Father Perry, and the frequent changes of secretaries during the present session, has caused some embarrassment to the acting council, and resulted in the delay of the issue of the *Journal*.

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Letters to the Editor.

M. BLANCHARD ON THE GEOGRAPHICAL DISTRIBUTION OF LIFE.

SIR,—It is somewhat strange to find in the *Comptes Rendus* of the French Academy of Sciences a lengthy paper by M. Emile Blanchard in which the general law that the fauna and flora of a country may supply important evidence as to its physical history is advanced as something which still requires to be made known. The author adduces as a special instance of this principle that the animals and plants of the Sunda Islands—up to "Wallace's Line," which he curiously abstains from mentioning—prove that these islands were once part and parcel of the south-eastern extremity of the Asiatic Continent.

M. Blanchard tells us that he came to this conclusion in a lecture delivered on April 13th, 1878. Possibly he is not aware that all he has to advance on the subject is to be found in Dr. Wallace's *Geographical Distribution of Animals, with a Study of the Relations of Living and Extinct Faunas as Elucidating Past Changes of the Earth's Surface*, published in 1876. The main idea was stated in the *Journal of Proceedings of the Linnean Society* for 1860! Hence, M. Blanchard's present paper must be pronounced as *Ilias post Homerum*.—Yours truly,

36, WRAY CRESCENT, J. W. SLATER.
TOLLINGTON PARK, LONDON, N., *March 7th 1890*.

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"PHYSICS OF THE EARTH'S CRUST."

SIR,—I have read with pleasure Mr. T. Mellard Reade's review of my "Physics of the Earth's Crust" (2nd Edition), which gives a fair general account of my views. But my meaning has been misapprehended in some particulars, and on these I should be glad to be allowed to explain myself. It is said that one of the "weakest points of the book" is where I "try to show" that lava, granite, and iron, expand on passing from the state of fusion to that of solidity. What I have endeavoured to do has been to collect the opinions of observers upon this vexed question, and at p. 52 the result is expressed in what was intended for a *guarded* statement that, "on the whole the evidence does not appear to be conclusive against, but rather in favour of the possibility of melted lava being capable of supporting a crust of the same lava when cooled;" adding that, "at the same time the possibility of a crust floating may depend upon an intrinsic difference in the proportions in which the constituents combine when freezing takes place." I believe it is known to petrologists that the heavier basic minerals crystallize out and subside, when the magma approaches the temperature of solidification. By this means a crust of diminished density would be formed.

Mr. Reade says that "it is inferred that the crust is denser and thicker under the ocean than under the land." What I *have* inferred is, that "the thickness of the crust beneath the ocean is certainly not much, if at all greater than beneath the land" (p. 246). It is no doubt more dense. But even if it was somewhat thicker, it might be possible that a column of it, being denser, *plus* the superincumbent column of water, might be as heavy as a column of the lighter continental crust, *plus* the subjacent column of magma extending to an equal depth. Thus it is not necessary that this "device" should "supply a state of unstable equilibrum." The conditions of this equilibrium are given at p. 238, (and at p. 165 of the old Edition) I wish to take exception to the word "device" applied in this instance. A "device" is something contrived for a purpose. Now, setting aside the confessed "speculation" in the last chapter, to which Mr. Reade has not made any reference, there are, as far as I am aware, only two "devices" in the book; and these are the fundamental hypotheses of the work. The first of these is the belief, shared by many geologists, that the crust rests on a liquid substratum. The second is that the steam and gases evolved by volcanos are original constituents of that substratum. These are the only "imaginative hypotheses," if they can be so called; every conclusion to which I have come appearing to myself to follow of necessity from these two. I consider "an hypothesis founded upon a series of hypotheses" to be an incorrect description of any statement to which I have committed myself.

It is suggested by the reviewer that the difficult question of compression ought to have been the first attacked. That however, is merely a matter of opinion. I do not profess to have discovered with absolute certainty any mode of action, which has produced this phenomenon. There may have been more causes than one which have contributed to it, and it may be true, as Mr. Reade puts it, that "every little has helped." When compression has been fully accounted for the grandest problem of physical geology will have been solved. My readers must be judges how far I have forwarded the solution of it.

A doubt is expressed whether "any series of convection currents are likely to arise in a molten fluid confined to a narrow zone or shell" such as I "postulate." It was not my intention to retain the supposition of this zone being a narrow one, as I had suggested in my first edition. If I have used any expression which can bear that meaning it has been done inadvertently. I formerly thought that, if the zone was shallow, the difficulty arising from the absence of bodily tides might be avoided. That was a mistake; and I have now faced the objection more fully, and believe that the observations on the tides lately carried out do not support this objection, and that even supposing they could be shown to do so, the difficulty can be met by the hypothesis of what has been called igneo-aqueous fusion, or, in other words, by the application of Henry's law to the substratum—which, as above stated, is my second hypothesis, devised primarily to account for volcanic action.

When I came to calculate the thermal relations of a thin crust to a liquid interior I at once saw that, if the earth has reached a respectable antiquity, convection currents are a necessity. This was a surprise to me, and quite a new light; and I at once perceived that it had an important bearing upon the phenomena of crust movements in general, and upon compression in particular. Here was no "hypothesis" founded upon "hypotheses" other than the original hypothesis that the crust is thin—unless it be considered an hypothesis that the antiquity of the earth is greater than eleven million years. Mr. Reade seems to consider that if convection currents are to be accepted, they will have been an effective cause of shrinking of the nucleus, and that thus the production of corrugations, according with the contraction hypothesis, will be facilitated. But I have pointed out at p. 354 that the layers successively added to the under side of the crust would always have been of the fitting size at the time of their addition. In that manner a second and lower level of no strain would be continually present, analogous in its effects to the layer at which, in the case of a solid earth, cooling would become insensible. Consequently no considerable increase of corrugations could be obtained by this means.

Harlton, Cambridge, 4th March, 1890. O. FISHER.

[NOTE BY THE REVIEWER.—The above explanations of Mr. Fisher's, with the exception of the last paragraph, do not appear to me to call for remark on the part of the reviewer. I fail to see in what way "layers successively added to the under-side of the crust of the fitting size at the time of the addition" affect the problem. If as I have stated, convection currents indicate more rapid cooling than what could take place by conduction, the decrease of cubic capacity of the nucleus would be more rapid on Mr. Fisher's hypothesis, and consequently, the radial contraction of the earth at the present time, if it had cooled by convection currents, would have been greater than if it had cooled by conduction. Therefore, if we accept the new hypothesis of convection currents, Mr. Fisher's careful calculations—which were made on the hypothesis of cooling by conduction, and go to show that the corrugations of the earth's crust could not have been produced by the shrinking of the nucleus—will have to be revised. The corrugation of the earth's surface, which neither contracts nor expands, must be directly proportional to the amount of radial contraction. The same, according to my view, holds good for the successive underlying shrinking concentric shells until the limit of the level-of-no-strain is reached. How a second level-of-no-strain could occur through the addition of solid accretions to the under side of the crust, as Mr. Fisher suggests, I am at a loss to understand.

T. MELLARD READE.]

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Publications Received.

Electrical Engineering for the Use of Students and Artizans, by W. Slingo and A. Brooker (Longmans & Co.); *Transactions of the Manchester Geological Society*, parts xvi. and xvii., vol. xx.; *Report of the Bristol Museum and Library; Proceedings of the Geological Society of London; Annual Report of the Liverpool Free Public Library and Museum. Nature Notes*, January, February and March. The following publications for March:—*Knowledge, Naturalist, Optical Magic Lantern Journal and Photographic Enlarger, Lyceum, Microscope, Brewers' Journal, and Journal of Conchology.*

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NOTICES.

Several Articles and Reports of Societies are unavoidably held over until the next number, when the following, among other important matter, will appear:—"The Salt Districts of North America," Part II., by Thomas Ward, J.P.; "On Some Apparatus Designed by the late J. W. Clark," by Professor O. J. Lodge, F.R.S.; and "Bees and Flowers," by G. W. Bulman, B.Sc.

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Communications for the Editor or intended for insertion should be addressed to the EDITOR of "RESEARCH," 9, Hackin's Hey, Liverpool.

TO CORRESPONDENTS.

Letters intended for insertion, should be written on one side of the paper only; they should be as short as possible, and, in all cases, contain the full name and address of the writer, whether for publication or not.

Secretaries of Societies are invited to forward reports of meetings and particulars of their future arrangements to the EDITOR.

Curators of Museums will oblige by forwarding details of new and important additions to their collections.

Communications intended for insertion in the following numbers should reach the EDITOR not later than the 12th of the month, but items of news and reports of societies' meetings will be received up to the 18th.

Notes on the Salt Districts of North America.

BY THOMAS WARD, J.P.

Part I.

IN the summer of 1889, I paid a visit to the most important salt districts of the United States and Canada. Several of these are of such recent discovery that no mention of them is made in the usual publications treating of such things.

From the date of the first colonization of North America, until comparatively recently, nearly the whole of the salt used was imported. The only salt district of any importance was that of Syracuse, in Central New York State. Salt has been manufactured in this district for nearly a century. About 30 years ago the salt deposits of Michigan were first commenced to be utilized in the neighbourhood of Saginaw. In 1862 the deposit of rock salt on Petit Anse Island, near New Iberia, in Louisiana, was discovered. The Canadian rock salt was discovered a little over 20 years ago, when a boring was made for petroleum. About 7 years ago the extensive salt deposits in the neighbourhood of Warsaw, in Western New York State, were discovered, whilst it was only in 1887 that the vast deposits in Kansas were found. In West Virginia, South Ohio, and Pennsylvania salt has been manufactured on a small scale a considerable time; and isolated deposits of rock salt in Utah and Arizona have been known for some time, but not worked. The largest and most important districts are New York State, Michigan, Ontario, and Kansas, and my remarks will be confined to them.

The formation of rock salt has not been peculiar to any particular geologic age in America. It is met with from the Upper Silurian to the present time; for the rock salt found in the "sink" of the Carson River and other dried-up salt lakes, as well as that being deposited now in salt lakes in Texas and Utah, is of the same nature as that found buried beneath the sedimentary deposits of countless ages.

As in our well-known English rock salt deposits, everything proves that the American rock-salt has been deposited at the bottom of salt lakes or in arms or gulfs of the sea, cut off from the main body by bars, and gradually dried up. The process to be seen now in full operation on the eastern shores of the Caspian Sea, and in the salt lakes of the Russian Steppes and other desert districts, is the same as has been common to all geologic ages.

Syracuse or Onondaga is the oldest salt manufacturing district in the United States. In 1797 there were about 600 tons of salt made there. In 1870 the quantity was nearly 220,000 tons, whilst in 1888 this had fallen to a little over 140,000 tons, in spite of the great increase in population. The competition of the new districts operated very prejudicially to Syracuse. Circumstances prevented me visiting this district first, as was my intention; but, after completing my tour through the other districts, I called here on my road to New York. The salt works of Syracuse are on the flat lands near Lake Onondaga. The Erie Canal and the Railroad make this a good centre for trade. The brine from which the salt is manufactured is not fully saturated, being usually only 70 per cent. of full saturation, which is 100%, as shown by the salometer. A fully-saturated brine contains about 26 per cent. of salt and 74 per cent. of water. The Syracuse brines contain about 18 per cent. of salt and 82 per cent. of water. No rock salt has been

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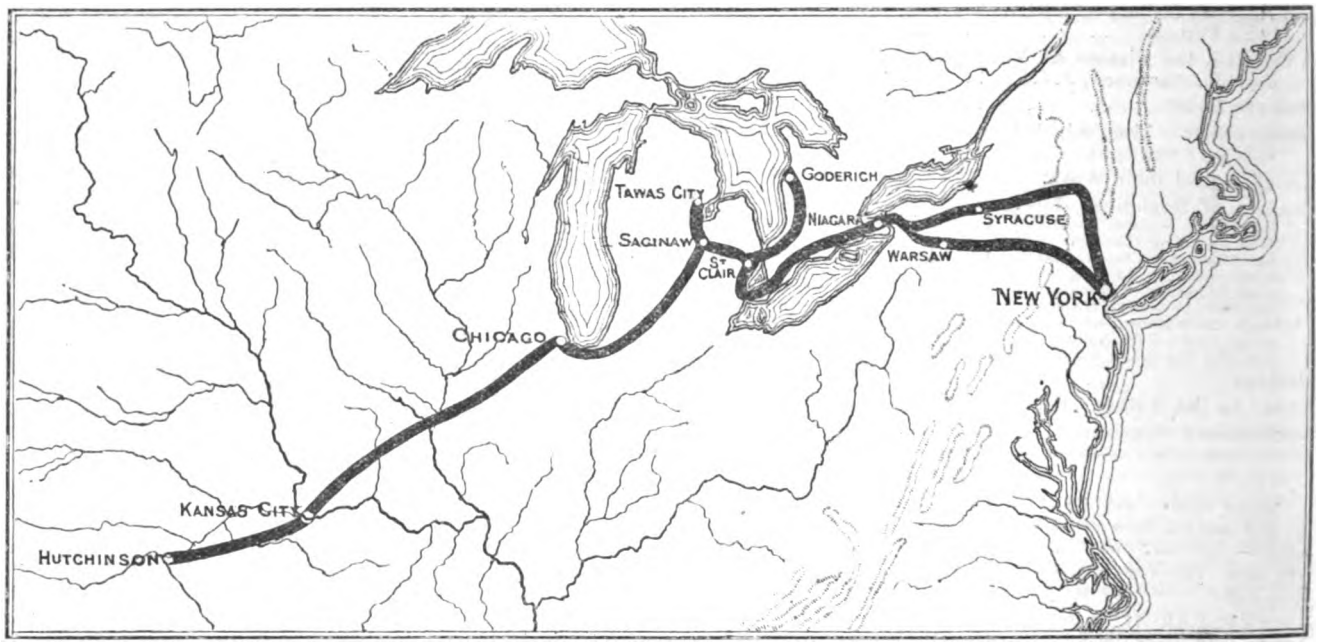
discovered at Syracuse; hence the brines which have evidently travelled some distance from the rock salt have become weakened by mixture with fresh water. Quite recently, rock salt has been discovered at Tully, about 15 miles to the south of Syracuse; and when I was at the Onondaga works in June, 1889, a scheme was on foot to make artificial brine at Tully, and convey it by pipes to the salt works to make salt. The present brine wells are on the low grounds near the lake, and are, as all over America, merely boreholes. They vary in depth from 140 feet to 300 feet, and are the shallowest I met with in America. The brine being so weak a large quantity of water has to be driven off before saturation point is reached and salt begins to form. I found three methods of manufacture in force, two of which, being those most intimately connected with the district, I will shortly describe; the third, being common to several districts, I will speak of later on.

The manufacture of white salt consists simply in driving off the superfluous water when the salt commences to crystallize out of the remaining liquid. A saturated brine is in a state of equilibrium. If any portion of the water is removed the equilibrium is destroyed, and a portion of salt crystallizes out and restores the equilibrium. If the removal of the water is continuous the formation of the salt is continuous also. The manufacturer keeps constantly removing the water by evaporation caused by heat. The heat of the sun is quite as efficacious as artificial heat, so long as it is not accompanied by moisture. At Syracuse there is made a large quantity of what is called "solar" salt; that is, salt made by the heat of the sun. In all hot, dry climates salt can be made in this way. The flat lands near Lake Onondaga present a very curious appearance. Scattered over them in long rows, with roads between, are some 40,000 "covers," as they are called, each 18 feet by 16 feet, and from 4 to 6 inches deep. These are really shallow wooden pans, if I may use the term, elevated a few feet above the level of the ground on wooden posts. If we can imagine a long, shallow wooden trough, some hundreds of feet in length by about 18 feet in width, and divided off every 16 feet by a narrow wooden partition, we should have a good idea of these solar salt pans. Standing back from the pans, so as to allow them to be fully exposed to the sun's rays, are a series of light wooden roofs, which are quickly run over the pans at the first signs of rain. Each section of 16 feet has its separate roof, and the partitions mentioned above are for the convenience of running the roof over the pan. If the rain were to get to the pans it would destroy the equilibrium of the saturated liquid, and a portion of the salt already formed would dissolve, so as to restore the equilibrium reversing the process of salt-making, and nullifying the work of days. The season for making solar salt is the summer and autumn, and only two "crops," as they are called, are harvested in the year. In 1888 nearly 80,000 tons of this solar salt were made. It is a very coarse-grained salt and very hard, similar to that which is used for fish-curing purposes at Yarmouth and other fishing ports.

To facilitate the making of the salt the brine is exposed on very large shallow "flats," as they are called. In running over these "flats" it presents a great surface to the sun and loses a considerable portion of its superfluous water, and thus commences to deposit its salt earlier in the "covers."

As no solar salt is fine, if a fine salt is required more intense artificial heat is applied. The simple salt manufacturing rule is—"the finer the salt the greater the heat, and the less time in the pan; the coarser the salt the less the heat, and the longer time in the pan."



The chief method of making fine salt at Syracuse is by "kettles." There are a number of what are called "kettle" blocks. The "kettle" is a cast-iron boiler very similar to those used in most houses for boiling water on washing day. These kettles are set in two rows of about 50 in a row over the flues from two fires. Those nearest the fires boil soonest and make most salt. The heat being greater the evaporation is more rapid. This double row of kettles forms a block. Sometimes, instead of setting the kettles upon flues, they are cased round, or "jacketted," as it is called. The "jacketting" or casing forms a chamber into which steam is forced. The steam serves the purpose of the direct heat from the flues.

In connection with some of the salt blocks are dairy mills or works, in which fine table salt and fine salt for dairy purposes are made. The salt is drained, and then dried by being passed through large iron cylinders 36 feet long by about 5 feet in diameter. These are called Hersey driers. They are heated either by direct heat from a furnace, over which they revolve, or by steam inside a casing. The salt thus dried is afterwards passed through mills and sieves, and packed in

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bags of all sizes from 1 lb. upwards to 2 cwts. The dairy mills are very extensive. One of them through which I passed was the largest wooden erection I saw in the States.

Many salt blocks were stopped at the time of my visit, owing to the decreasing trade. The district is a very interesting one and well worth a visit. The following is a section of one of the chief bore-holes :—

Clay	170 feet.
Clay and Gravel	4 ,,
Clay	20 ,,
Coarse Black Sand	89 ,,
Smooth Washed Gravel	2 ,,

In this gravel the brine is met with. It will be impossible for Syracuse to compete satisfactorily with her weak brines against the newer salt districts with saturated or nearly-saturated brines. At the moment of writing, attempts are being made to get a reduction of State duties, so as to enable competition to be successful.

The Western New York salt district in the valleys of the Genesee and Wyoming rivers was the first visited by me. It is of comparatively recent growth, salt only having been discovered in 1883, when borings were being made for oil. The country in the neighbourhood of most of the works is very pretty, and the district over which I drove one of the pleasantest I saw in America. The extent of the salt formation—which is probably not continuous throughout—is said by General James S. Wood, in a speech made at Albany in March last, to be about 2,000 square miles. The district through which I went might be about one-fourth of this.

The rock salt and brine lie at very considerable depths. At Leroy, the most northern place where salt has been bored, the borehole was 1,003 feet deep, and the surface of the salt was 140 feet below sea level; whilst at Castile, one of the most southerly points where salt is made, the bore hole was 2,373 feet deep, and the surface of the salt 969 feet below sea level. Where brine does not naturally exist—and this is frequently the case—water is put down the boring, and after saturating itself upon the bed of salt is pumped up to make salt. Brine is merely ordinary spring or fresh water that has come into contact with rock salt and has dissolved a portion of the salt. In some cases the salt solution contains about 26 per cent. of salt; it is then fully saturated and will take up no more. The pumping of brine for the manufacture of salt is merely salt mining by means of water. It is very much cheaper than the ordinary methods of mining, and, besides, it leaves behind all refuse, merely bringing up the pure salt. The whole secret of making white salt is to drive off the water that has dissolved the salt, and so leave the salt behind.

The boreholes have a lining tube, and a second tube within this. The water is put down the space between the two tubes, and, after coming into contact with the salt and taking up a portion, it rises up the central tube 5 feet for every 6 feet of height in the fresh water put down. The specific gravity of brine is roughly 1·2, so that it requires 12 feet of fresh water to balance 10 feet of brine. The brine is pumped up the remainder of the distance. The boreholes are generally about 5 inches in diameter and the internal tube about 3½ inches, and this is the size of the pump barrel. The boreholes are made on the American principle, with the rope and weighted cutting chisel. The holes are soon made, but the material passed through is broken up and satisfactory cores cannot be obtained. In this district I met with what is called "well forcing." It is carried on also in the St. Clair district of Michigan and in Kansas. Instead of putting the fresh water down the space between the tubing, and letting the brine rise as high as it would in the central tube and pumping it the remaining portion, force pumps are used and the fresh water forced down at a pressure sometimes of 160 lbs. to the square inch. By this means the brine does not require pumping, the force being sufficient to drive it to the top of the pipes, from whence it runs to the reservoirs. I found this system to be a favourite one, and it is certainly a very beautiful one. It has an advantage over the gravity system; for, if the pipes get choked, instead of forcing the water down the concentric cavity of the brine and up the central tubing, the proceedings can be reversed and the obstruction removed. The system of mining rock salt by water put down concentric tubing has been in operation in Germany for a number of years, and has recently been commenced in the south Durham salt fields. It is most satisfactory in districts where the salt lies deep, and where the overlying strata consist of hard rocky material. The removal of the salt near the bottom of the tubes leaves a cavity, which continually increases in length, breadth, and depth, the latter depending on the thickness of the bed of salt; this varies from a few inches to several hundred feet. When the cavity gets large, unless the overlying strata are very tenacious, subsidence takes place, and the borehole is destroyed and the surface of the land injured. Where the overlying rocks are thick the process of pumping will go on a long time before any subsidence occurs; but when the fall of the earth takes place it will be very serious. It would seem, from a speech made in the Albany house of representatives, New York State, in March last, by General Wood, that subsidence has occurred in the Wyoming valley. He says "there has also been great loss after the brine was pumped out, by the falling of the rocks." The effects of water on beds of salt may be seen in our own Cheshire districts, where the subsidence of the land is so serious.

The salt works in Western New York are mainly near Warsaw, on the Wyoming river. At Piffard, near the Genesee river, are several interesting works, and also the only rock salt mine in America, prior to the completion of the Kingman Shaft in Kansas this year. The rock salt in Louisiana, on Petit Anse Island, may more properly be said to be quarried. The Retsof mine is 1,010 feet deep. The bed of salt being worked is not very thick. I did not go down the mine, but saw the salt in large quantities. The salt deposits of New York State are in the Upper Silurian. The typical section of the whole of this district is :—

1st. Clays and Gravels.
2nd. Limestones and Dolomites.
3rd. Salt-bearing Marls.

We have the clearest proof here, as in most if not all other rock salt deposits, that rock salt is a crystallization out of the saturated waters of salt lakes. The marls which invariably accompany it are brought in during the rainy season of the year by the flooded streams running into the lakes.

In Western New York I met with what are called "grainers" for the manufacture of salt. These are long wooden pans, averaging 120 feet in length by about 12 feet in breadth, and about 22 inches deep. The salt is drawn from the pans upon a platform, extending the whole length, of the "grainer" up the centre; thus the brine draining from the salt runs back into the pan. On the bottom of the grainer are pipes about 4 inches in diameter, through which steam is blown. The brine is thus heated and the water driven away without any furnaces being near. The steam is generated in huge boilers and conveyed through the grainers, and the exhaust steam is sometimes turned into smaller grainers called "dividend" grainers, the salt produced in them being considered all profit, and so producing a dividend; or else it is turned into pipes running through huge wooden reservoirs several feet deep, called "settlers," where the brine is allowed to settle and to become heated before being turned into the grainers. The question as to which method is most economical, live steam or open fires, is not settled. The great abundance of wood in America and the dearness of iron, coupled with the ease with which a "grainer" could be constructed and repaired as compared with an iron pan, no doubt forced the salt manufacturers to use wooden grainers. Boilers and pipes are easily obtainable, ready made whilst iron pans must be made on the spot.

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Nothing struck me more about the American salt works than the lavish use of wood. In grainer works it was wood everywhere. In one of the works, the Empire Dairy Works, the grainers were lined with a slatey stone, which was said to be very valuable in preserving them.

Most of the works in this district had several wells or boreholes; some as many as five. The brine generally required treating with quicklime to take out impurities. This need of lime treatment caused a large number of settling tanks or reservoirs to be used, which varied according to the capacity of the works. At the Warsaw Dairy Company's Works, some of the best-appointed and most beautiful in America, there were 17 settling tanks. At the Crystal Salt Company, Warsaw, where the works had been recently rebuilt after a destructive fire, and which were perhaps the most compact and complete set of works that I visited, there were no less than 21 wooden settling tanks, each 32 feet in diameter and 8 feet deep. At these works there were five iron pans, under which petroleum was consumed. It was here also I saw the system of well-forcing described before.

The salt works in this district were alongside railways. The Genesee and Wyoming rivers were more beautiful than useful. Not being navigable it was useless putting the works on the low grounds on their banks, especially as the railways were on the high lands.

The great bulk of the salt made in America is sent away in barrels containing 280 lbs., or 8 to the English ton. In speaking of the Michigan district I will give a description of the barrel and its manufacture. Whilst writing this I learn that a thick bed of rock salt has been discovered at Cleveland, Ohio, on the borders of Lake Erie, and salt works are to be at once set up.

On my way from Western New York to Michigan I stayed a short time at Niagara. The celebrated "falls" have been so frequently described that I will not attempt a description. What struck me most was the deep gorge cut by the water. As the process of cutting back is still going on, and the amount of rock removed during the few last decades recorded, a measure of the time required to form the gorge may be roughly estimated. The American or shallower fall comes in at the side of the gorge, whilst the Canadian or the deeper and wider fall seems to be cutting away the rock and doing all the work. The magnitude of the falls did not at first impress me; but, as I stood and looked on and heard the continuous roar of the falling water and saw the mighty stream rolling on, and thought that like Tennyson's "brook" it went on "for ever," my mind went backward to the time when the limestone rocks were deposited which are now being slowly eaten away by the relentless stream, and forward to the time when the gorge shall have extended itself to Lake Erie. I asked myself how old this world of ours might be when one of the latest works upon it has been going on many thousands of years. These rocks now being cut away are buried under from 2,000 to 3,000 feet of salt marls, limestones, slates, and gravels in New York State, which themselves have been deposited so long since that the Genesee river has had time to cut its way through fully 200 feet in thickness and many hundred feet in length of these slaty rocks, and to form beautiful gorges. The immensity of time required for the formation of the country for a distance around Niagara, and the enormous forces at work slowly but surely altering the face of nature and preparing mighty changes in the future, deeply impress the mind and make one think what a tiny, insignificant thing is man, and what a small portion of the world's history he has shared in.

Nothing that I saw in America so deeply impressed me as Niagara with its surroundings, and when afterwards I saw some of the mighty lakes and knew that their overflow water passed over the Niagara Falls, the impression made was intensified.

I left Niagara for Michigan to see the extensive salt works there, which I will describe in my next paper.

(To be continued.)

Minerals at the Paris Exhibition of 1889.

By Wm. Semmons.

IT would seem to be an act of great presumption to attempt to give an account of the mineral exhibits at the "World's Show," but possibly the following notes, taken during a rapid glance, may interest some of the readers of *Research*. Two points of very different characters struck one: first, the great preponderance of the New over the Old World in mineral exhibits, and, second, the prevalence of the idea amongst exhibitors that the labels describing the stones ought to be covered over by them.

From Alaska to Patagonia all the states of the New World seem to be prolific in minerals, and some are represented in full detail. Dealing first with the United States of North America, we find the two collections of A. E. Foote and Tiffany & Co. furnish us with splendid examples, the one of metallic ores and the other of the gems. Foote seems occasionally to revel in "big" things, whilst Tiffany confine themselves almost entirely to small cabinet illustrations. The largest diamond from the United States exhibited weighs about ½ carat, and comes from Kentucky, but there is shown a model of the "Dewey," which weighed over 23 carats, and was found near Richmond, Virginia. Tiffany also exhibit diamonds from South Africa, Brazil, &c., and also illustrations of the peculiarly hard variety that has lately been found, and which has been described by their expert, G. F. Kunz. They also show, from North Carolina, a cut ruby 1½ carat, sapphire (blue and green crystal) 16 oz., and an emerald (doubly terminated crystal) over 8 ounces.

Amongst Tiffany exhibits from the United States were—

Beryl, cut as a gem, 133 carats.

Topazes of fine colour, brilliancy, and size.

Garnet, crystal of fine colour, 14 lbs., and gems up to 96 carats.

Tourmalines, crystal of green exterior with white and red centre; also, crystals of blue, red, pink, lavender, green, white and black. A very fine series.

Zircon, brilliant brown crystals; also, one green.

Quartz, in beautiful, clear, colourless crystals, from 7,500 to the ounce up to large sized ones. Rose quartz, and citrine.

Amethyst in crystals, and one cut stone 66½ carats.

Opal of various kinds; fire opal from Oregon shown is the first known with a play of colours in the States.

Rutile, beautiful crystals from North Carolina, presenting their characteristic peculiarities.

Dumortierite, two magnificent specimens resembling *lapis lazuli*.

Rhodonite, polished stones, and in crystals of delicate rose colour.

Cut and polished stones of Cassiterite, Chalcedony (enclosing Cinnabar), Gadolinite, Sodalite, Scapolite, Chondrodite, Cyanite, Prehnite, Chlorastrolite, Pectolite, Schorlomite, Isopyre, Calamine, Willemite (canary), Beryllonite (a new gem), Microlite, Samarskite, Malachite.

In fact, this collection of polished stones is unrivalled, and one is not surprised to learn it has been awarded the Grand Prize, and their expert, Kunz, a gold medal.

Mr. A. E. Foote, a most indefatigable collector, shows an enormous crystal of quartz weighing many hundred pounds, and said to be the largest known. He also shows from Pike's Peak the largest known crystal of microcline. He is strong in the ores of copper and lead from Arizona, including among the former the celebrated banded blue and green carbonates, and in the latter the charming red vanadiates and molybdates of that State.

The State of Nevada exhibits a large collection of ores, principally gold and silver, but, with the exception of the yellow molybdate of

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lead, they present but little beauty to any observer except a miner.

Arizona makes a fine display of various coloured fossil woods from her petrified forests.

Chili, Bolivia, and Peru show each of them large quantities of Argentiferous and Auriferous ores, including earthy carbonates of lead and galena. They also show fine stones of native silver and some beautifully-crystallised specimens of Pyrargyrite and Proustite. One noticed in the copper ores: Chalco-pyrite, Erubescite, Chalcocite, Chrysocolla, Brochantite, Atacamite, Malachite, the Barilla of Coro Coro, and a large number of arborescent forms of native copper. Some of these last named placed on white paper and framed made pictures of an interesting appearance.

The Argentine Republic makes a very large show of its mineral resources. Crystals of native gold, native silver, and Argentite are displayed, as well as a large assortment of Argentiferous ores in the amorphous condition. Here, too, is a very well labelled and instructive series of ores and rocks lent by the University of Cordoba. Venezuela displays many good stones of gold and silver ores, also some copper minerals. Ecuador shows a few stones of gold ore.

Brazil makes a fair display of gold and silver ores, some crystallized specimens of the former being very beautiful. We noticed, too, several fine crystals of Beryl Aqua-marine, Topaz and Amethyst Quartz, also several crystals of Diamond both in the matrix and detached therefrom.

Mexico, in my opinion, has the finest exhibit in the Exposition except, perhaps, the United States. Some of the mining companies have made special efforts, and in one case a tunnel has been made of mineral products several feet long. Gold is displayed in fine pieces of rock and also in beautiful crystallizations. Of Amalgam there are exhibited, perhaps, the two finest specimens ever seen in Europe. Silver is shown in its native state, and also as Argentite, Pyrargyrite and other ores. Copper is well represented by Chalcocite, Erubescite, and Copper Pyrites, and by a large series of Silicates (Chrysocolla); the latter from the celebrated Boleo Mine. Some interesting Selenides of Lead and Copper attracted Mineralogists to this court, also the series of Bismuth, Antimony and Cobalt ores. Torquoise, a fine collection of Opals, and a series of Topazes (the latter in the matrix) illustrate the gems. Here, too, we noticed Tridymite, fine Apophyllites (pink and green), Stilbite, and other Zeolites, very fine and clear crystals of Calcite, large and well-defined crystals of Fluor Spar, some good amethystine Quartz, and a remarkably opalescent Chalcedony between layers of Chrysocolla. Our review of this exhibit must conclude with noting the pillar of Mexican Onyx that arrested the attention of all visitors to the court.

Africa is represented by a very fine show of gold nuggets and ores from the South African Republic, and by a series of copper and lead ores from Algeria.

Spain, as might have been expected, after the Barcelona Exhibition, makes a fair show of Manganese and iron ores from Bilbao and Cartagena, also of Blende, Calamine, and of several ores of lead.

Greece sends good samples of the zinc ores from the old mines at Laurium, such as Calamine, Smithsonite, Adamine, Buratite, and Serpierite.

Norway has good examples of native silver and the ores of that metal, Copper Pyrites, and Erubescite. There was also shown here the unique crystal of Broggerite (now acquired by the British Museum), and some remarkable Molybdenite.

Russia exhibits fine tables, vases, &c., of Malachite, Rhodonite, and Lapis Lazuli, but one was surprised to see in this court tables made of the petrified wood of Arizona, and of the Crocidolite of South Africa.

European minerals, particularly British, were but poorly represented, but probably there was never before presented such an opportunity of studying the mineral products of the New World as was to be met with in the Paris Exposition of 1889.

Lead Pollution of Drinking Water.

By E. Howarth.

In 1885 the subject of the contamination of the drinking water in Sheffield by means of its solvent action on lead pipes was brought before the Health Committee of that town, in consequence of the occurrence of chronic lead poisoning, or plumbism, which could not be traced to any evident source. This led to a long and exhaustive inquiry by Dr. White, the Medical Officer of Health, in order to ascertain the source of the lead pollution and the best means of preventing it. Since that time, and up to the present, the subject has agitated the public mind of Sheffield to a large extent, and there is no doubt that a great deal of disease has been caused by lead poisoning, and at least two deaths have occurred from it. In February last a commission, consisting of the Mayor and some members of the Town Council, aided by Dr. S. Bristowe, Professor James Dewar, Mr. Thos. Hawksley, C.E., and Mr. E. M. Eaton, C.E., Water Engineer to the Corporation, as experts, was appointed to take evidence as to the prevalence of lead poisoning and its cause. This inquiry has resulted in the publication of a mass of evidence on the question, which shows that lead is dissolved in part of the water supply when drawn from the taps of consumers. The subject is one of such importance that a brief account of the facts will probably be found interesting to the readers of *Research*.

The water supply of Sheffield has two sources, one being from the hills around Redmires, about six miles S.W. of the town, and at an elevation of about 1100 feet, where the water is collected in reservoirs near its source. The other collecting ground is at Strines, also on the western side of Sheffield but more to the north than Redmires, and is on a much lower level and a few miles more distant, and where there are also large reservoirs for holding the water. Sheffield is a town built on many hills and in their dividing dales, so that the levels of the town vary very greatly, and thus it comes about that the water from the Redmires or High Level system supplies the higher parts of the town, and the water from the Strines or Low Level system supplies the lower parts, the limits of the two systems being tolerably well defined. The water from both these collecting grounds is carried by means of conduits to service reservoirs nearer to the town, the water from each system passing into separate reservoirs, though close together, and the only admixture of the two waters that occurs is when the supply from Redmires is more abundant than is necessary for the wants of its system, and then it overflows into the Low Level reservoir. As the district in which lead poisoning appeared to prevail was confined to the area comprised in the High Level system of supply, steps were taken to ascertain what was the difference in the water supplied from the High Level and from the Low Level system, whereby the former had the property of dissolving lead, while the latter was innocuous in this respect.

The Redmires or High Level water is collected from moorland with surface peat, varying from a few inches to several feet in thickness. Underlying the peat are shales and millstone grit of the Carboniferous system. Both the peat and shale contain iron pyrites, and "ochrey" springs are common. The Strines or Low Level water is collected from ground closely resembling that at Redmires, but owing to the configuration of the surface there is less tendency for the water to stagnate, and the peat is consequently drier, being also less abundant, and fine sand frequently comes to the surface. The High Level water gave a decided acid reaction when tested with sensitive litmus paper, both at the collecting grounds and in the service reservoirs; but the Low

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Level supply failed to give an acid reaction in the reservoirs, and only faintly so at the collecting grounds. It seemed probable that the action of the water on the lead was due to the presence of a free acid in the water, but the nature of the acid has not been determined, though it is probably of vegetable origin, and not due to the oxidisation of the iron pyrites, which would give off sulphuric acid. Samples of water taken direct from the iron main showed no trace of lead, but after passing through the lead pipes in the houses a very appreciable amount of lead was found in it. This had no doubt been dissolved from the lead pipes by the water, and the amount of lead generally varied according to the length of pipe the water passed through and the time it had been in the pipe. Water taken from houses with long-communication lead pipes contained more lead as a rule than where short-communication pipes were used, and the use of lead-lined cisterns also tends to increase the amount of lead taken up by the water, more especially when the cisterns are used for hot water. In 28 analyses made of water taken from 28 different houses in the morning, when the water had been standing in the pipe some hours, the amount of lead present varied from ·07 grain per imperial gallon to ·70 grain; while in samples taken from the same houses in the afternoon the quantity of lead in nearly all cases was decidedly less, ranging from ·07 to ·56 grain per gallon.

As all authorities are agreed that the presence of lead exceeding ·10 grain per gallon is decidedly injurious, and, in many cases, even ·05 or less is prejudicial to health, the condition of the water as drawn from the taps in the houses of consumers, and which contained lead varying from ·70 to ·07 grain per gallon, was undoubtedly a great danger to health. Mr. A. H. Allen, the Borough Analyst, in his evidence before the Commission produced an "ingot" of lead about the size of a six-penny piece which he had extracted from 30 or 40 gallons of the hot water supply in his own house, and the medical testimony all went to show that lead poisoning from drinking water existed to a considerable extent in Sheffield, some of the medical men having met with from 50 to 80 cases in their practice during the last three or four years. Mr. Eaton, the Corporation Engineer, is of opinion that, notwithstanding that the general condition of the collecting grounds and reservoirs is the same as it has been for the last 50 or 60 years, the fact of lead having only quite recently been found in injurious quantities in the water may be accounted for by the smaller amount of mineral matter which finds its way into the water, in consequence of all feeders and drains, which in times of flood caused the water to become turbid, having been from time to time diverted, thus making the water purer, but at the same time possibly removing the base with which the acid might have been neutralised. A further cause may be the greater purity of the lead, which has taken place recently by the more careful removal of silver from it, and no doubt the more exact methods of scientific investigation have assisted recent discoveries as to the presence and action of lead.

The pressure of the water had a very marked effect on the quantity of lead dissolved, for in an old lead pipe 24 feet in length the following results were obtained:—Under the normal pressure of 140 lbs. to the square inch (=320 vertical feet of water), the water after standing in the pipe for four hours contained 0·28 grain of lead per gallon, and after standing 14 hours 0·35 grain per gallon, while water in the same pipe with the pressure removed contained 0·14 grain after four hours, and 0·21 grain per gallon after 14 hours. The same experiment, tried with a new lead pipe, gave practically the same difference in the result, though the quantity of lead dissolved was greater. That the water would act more vigorously on new than old lead might be expected, for the old lead would become partly covered with a protective deposit in course of time. In the experiments conducted by Dr. White he found that by treating the water with lime before it entered the lead pipes the acid could be neutralised, so that the water did not dissolve any lead, but that if more than half a grain of lime per gallon were used it lost its beneficial effect. Another experiment gave the following result:—Derbyshire limestone, broken into pieces the size of a hen's egg, were placed in a receptacle. Water from the iron main was allowed to stand in contact with the limestone for various periods of time, and afterwards stored in the lead pipe. Water not treated in this way took up 0·28 grain of lead per gallon, but the water, after being in contact with the limestone for half an hour, two, 18, and 24 hours respectively, showed but a very slight and harmless trace of lead. After lengthened use, however, it was found that the limestone became coated with a protective covering of peaty matter, and thus lost its power of neutralising the acid. This method of treating the water appears to be highly beneficial, provided the surface of the limestone is kept clear. In continuation of this experiment Mr. Eaton added flint to the limestone with the view of silicating it, and thereby obtaining a coating of silicate of lead on the pipes and thus protecting them from any acid reaction, but these experiments have not been extensive enough to give any definite results.

One objection to the lime treatment is its effect in making the water hard, and some of the manufacturers feared that it might reduce its value for trade purposes by causing "crust" on the boilers. The risk of this is not very great, for the quantity of lime necessary would be so small as not to have any appreciable effect on the boilers, while the removal of the acid from the water would prevent the corrosion which it now causes.

Further than this: the Sheffield water is deficient in lime salts, it having only two degrees of hardness, while London water has 15, one result being that the disease known as "Ricketts," caused by imperfect bone development, is very prevalent in Sheffield, where also teeth decay goes on with unpleasant rapidity. The addition of lime might be beneficial in these respects, but the change would not be of much importance, for the hardness would only be increased by about half a degree.

As there is no doubt that the water when it leaves the water-mains is entirely free from lead, and that the lead is taken up by it from the lead pipes and fittings of the consumers, it is obvious that, by removing these lead pipes and fittings, the water would remain pure for drinking and domestic purposes. Various forms of pipes have been invented lately, such as glass-lined or tin-lined pipes, through which there would be no contact with lead, as would also be the case with iron pipes; but these are more expensive and not so convenient to work as lead, and it could hardly be expected that in the thousands of houses already fitted with lead pipes these can be replaced with pipes of other materials. But in the case of new houses this should be done, and the Corporation ought not to allow lead water pipes to be used. There is, however, another efficacious means of preventing lead poisoning that is within the reach of householders themselves, and of easy application. This is the carbon or iron filter, for all these filters entirely remove the lead from the water; and, not only so, but filters containing animal charcoal take away the power of the water to act on lead.

Doubtless the best way to deal with the water is for the Corporation to rob it, if possible, of its dangerous qualities, and this they are anxious to do for at the close of the inquiry they came to the following conclusion, after hearing the important medical, chemical, and other evidence that was tendered:—"That such of the inhabitants of Sheffield as use Redmires water for drinking purposes are liable to be injuriously affected by the presence of lead therein, as derived from the pipes and cisterns of the consumers," and "that by way of practical experiment a small but sufficient quantity of chalk, in a state of minute division, which will not prejudicially affect the water for domestic or manufacturing purposes, be added to the water at or near Redmires before its distribution to the town."

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Ships: Their Preservation from Fouling and Corrosion.

By Richard Holland.

ONE of the greatest difficulties which navigators have to contend with is the facilities which the submerged portion of a vessel presents to the attachment of the lower forms of marine life. Such organic encumbrances offer a serious resistance to the passage of a ship through the water, and at the same time tend to produce a speedier decay of the material of which the vessel is built. As far back as the time of Julius Cæsar, the Veneti were justly famed as shipbuilders, their vessels attaining the extraordinary dimensions of from 1,200 to 2,000 tons. They early recognised the necessity of providing a remedy to protect their oaken galleys from the devasting ravages of the insect inhabitants of the Mediterranean Sea. It is placed upon record in the reign of Marcus Ulpius Trajanus, A.D. 98-117, that they were in the habit of casing the lower part of the hulls of their ships with a thin skin of lead, and this skin they fastened to the timbers with copper nails. The speedy oxidation of iron bolts and fastenings had led to their supercession by copper and brass about the time of the Emperor Nero, some half a century prior to the adoption of the lead sheathing. The Phœnicians of the same date would appear to have used a composition consisting chiefly of asphaltum to protect the immersed portions of their vessels against fouling and the worm. In more modern times the timbers of wooden ships were enclosed in a thin deal casing, upon which the teredo and the molluscs were allowed to attach themselves. By removing the boards at the end of a voyage, and replacing them with new ones, the submerged hull was protected, and the ship's rate of speed diminished as little as possible by the removal of the organic parasites before they had attained to mature growth.

In the middle of the 16th century an anti-fouling composition was invented and duly patented by a William Beale, a London goldsmith. He agreed to pay the sum of 40/- a year to the King for "the sole making and practice of certain compound stuffs, extracted out of certain minerals, called by the name of dressing for ships, to prevent them from burning in fights at sea, and also from the sea-worm or barnacle." But with the advent of the use of copper and yellow metal for sheathing purposes, anti-fouling compositions would have seem to have lapsed into desuetude until the building of iron ships rendered their use an absolute necessity.

It would appear that the efficacy of the copper is determined by means of its gradual oxidation when exposed to the action of sea water. By virtue of this process *verdegris*, which is fatal to marine life, is formed, and thus the vessel is ensured a clean bottom. But the more effectual the copper sheeting is the more expensive it is also, for as the oxidation process is a consuming one, and the scarcity of marine organisms upon the immersed hull is dependent upon the amount of poison formed, it follows that effectual cleansing can only be ensured by a rapid consumption of the copper, and as a consequence the sheeting requires renewal every few years. To prevent this loss various methods have been devised. Sir Humphrey Davy applied what he termed protectors, consisting of pieces of iron and zinc placed upon different parts of the copper. The action of the water, aided by the salts in solution upon the two metals, produced a weak galvanic current, sufficient to prevent the oxidation of the copper. By this means the waste of the copper was obviated. Unfortunately, however, the efficacy of the copper is, as we have shewn above, directly proportional to the amount of oxidation. The waste, it is true, was prevented, but the copper on the submerged hull became rapidly encrusted with barnacles and seaweed, the very organisms it was placed there to destroy. This plan would no doubt be perfectly efficacious in the case of hulks, or ships stationary in harbour, because the copper, protected from oxidation by the galvanic current, would offer a mechanical barrier to the penetrative powers of the teredo and other worms that prey upon the wooden planking of ships, while since the vessel was stationary the encrustations upon the surface of the copper would cease to cause inconvenience.

The extensive adoption of iron and steel as a ship-building material, and the utter impracticability of encasing iron vessels in wood, lead, or copper, have long presented to nautical experts a most interesting and important problem—viz, the providing of a substance whose use must not interfere with the passage of the ship through the water, and which shall possess the valuable properties of preventing the encrustation of barnacle and seaweed, and, at the same time, checking the corrosion to which all exposed iron and steel is subject. The benefits, both economic and otherwise, which a perfect anti-fouling composition would confer upon mankind in general, and the shipping interests in particular, are such as to make the finding of one as much an object of search to the nautical *savant* as was ever the philosopher's stone to the Alchymist of old. Before maritime science had determined the conditions under which an anti-foulant and corrosive should be applied to the hulls of iron vessels, various efforts were made to protect them in much the same method obtaining among modern ships. Some twenty years ago an iron barque, built at Jarrow-on-Tyne, was sheathed with zinc sheets, but at the end of one voyage it was found that the sheets had practically disappeared, and its future application was abandoned. There is no doubt, however, that, so long as the zinc sheets remain intact, there is no corrosion of the iron or steel. The cost of the sheathing was, however, some 10s. per yard, and, when this is added to the monetary loss experienced when a large vessel has, in these days of rapid passages and keen competition, to lay up some ten days to be encased in zinc, it will be seen that the above remedy, though efficacious, is far too costly.

Another application of the above plan was the following:—The iron hull below the water was covered with wood sheathing, one to three inches thick, and to nail the zinc, copper, or yellow metal over this. There is, however, besides the objection that this would decrease the speed of the ship, the additional drawback that water is very liable to penetrate between the wood and the iron skin of the ship, and thus cause corrosion, which would be unsuspected until the wood was removed. Moreover, the wood covering has to be fastened to the ship by iron or copper bolts, which in either case serve as a contact between the iron hull of the vessel and the copper and zinc sheathing, thus setting up a galvanic action which is highly destructive to the hull of the ship.

Of the loss which shipowners incur through corrosion it would be most difficult to obtain an approximation, but as to its great magnitude all are agreed. It is not so, however, with fouling, an arithmetical application of the old adage, "Time is money," will often enable a shipowner to determine the exact loss incurred by the slow passage of the vessel consequent upon her bottom being fouled by barnacles and sea-weed. The difference between the outward and homeward passages of vessels trading to the East Indies, China, or Australia is notorious, and can but be attributed to the encrustations of barnacles and sea-grass. These impedimenta to fast sailing are not, however, to be experienced in the same degree in all waters. A vessel in the North Atlantic trade does not require so much poisonous matter in the composition with which she is coated as does one in the East Indian trade.

As a general rule, the nearer the Equator the worse the chances of fouling, and in the northern waters the higher the temperature of the water the greater the danger. Suez, Jeddah, Aden, and, in fact, all Red Sea ports, produce fouling at all seasons of the year. Bombay, Kurrachee, Ceylon, and the Malabar and Madras coasts are worse during the prevalence of the N.E. monsoon. Calcutta and the Burmese rice ports produce fouling in a much slighter degree than the Indian ports

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above mentioned. This is, probably, owing to the fact that they stand at the mouths of rivers, the waters of whose estuaries is brackish, or, during seasons of flood, almost entirely fresh. Java is bad all the year, Sourabaya being, probably, the worse port known. The Mediterranean is less dangerous than India, and produces, principally, marine-grass. This grows in all the salt water ports in great abundance during the summer months. To the grass, Alexandra adds the additional foulant of small shells, which flourish in great abundance during the months of April, May, and June. We have alluded above to Sourabaya being the worst port in the world for fouling. Taking the average of 12 steamers making the voyage between England and Java home: the outward voyage on an average of the 12 steamers occupied about 40 to 45 days, the homeward voyage on the same average 65 days.

An anti-foulant composition is valuable according to the manner in which it exfoliates, provided that the exfoliation, or scaling off, is accompanied with the formation of a poisonous fluid, fatal to parasitical life. The exfoliation is the result of slow oxidation, and it is patent that where a gradual scaling, or filming off takes place, barnacles and marine-grass that may have attached themselves to the hull of the vessel are detached along with the film.

In the English coasting trade, and the North Sea and Baltic trade, probably the old-fashioned black varnish and blacklead is a perfectly efficacious anti-foulant, because the carbolic acid, which it should contain, is fatal to the germs of marine organisms. This is only practical, however, when the interval between the application of two successive paintings is short. No doubt the best paints of all are those which contain copper, mercury, or zinc, and the concensus of opinion would seem to be greatly in favour of the copper.

When the copper exfoliates by reason of the action of the sea water, assisted very materially by the sodium chloride which constitutes some 2·7 per cent. by weight of ocean water, a poison, oxychloride of copper, is formed fatal to life. This zone of poisoned water surrounding the ship destroys all animal life that enters it, and even supposing the barnacles may have attached themselves to the vessel's side, the zoophytes are first killed, and then the exfoliation process comes into play and detaches the shell. Were exfoliation the only process necessary to bring about the detachment of the obnoxious intruders, then bare iron would be more efficacious than a composition containing copper, for the iron undergoes more than four times the amount of corrosion than the copper does. The zone of water, however, surrounding an unprotected iron hull is not sufficiently poisonous to organic germs, save in the coldest seas.

In the manufacture of anti-corrosive compositions, history would seem to have repeated itself. From the earliest periods the Chinese appear to have applied to structures, liable to disintegrate under atmospheric influences, soap-stone or steatite. This mineral, which is a compound of oxide of silicon, combined with magnesia and varying proportions of alumina and water, has been applied to Chinese obelisks in the form of a powder, and has preserved them and their hieroglyphical inscriptions unimpaired by the weather. The action of the soapstone is essentially anti-corrosive, and as such is prepared for application, either to the outside or inside of iron and steel ships. It has, however, an additional recommendation, which pre-eminently adapts it as a constituent of protective paints, and that is its extreme fineness of grain, which gives it sufficient adhesive properties to lay hold of the fine fibre of the iron or steel, and thus protect it from atmospheric influences. Perhaps the best known and most highly prized varieties of soapstone is agalmatolite, which contains a little potash, and is used in the manufacture of exquisite specimens of Chinese sculpture and carving. The anti-corrosive compositions with which the inside of steamers are painted have not only to bear the disintegrating attacks of the atmosphere, but must also withstand the continuous shock of vibration. The use of silicates, such as the soap-stone, here alluded to, in paints for protecting the iron and steel of ships from loss by oxidation is well worth further trial, and will probably prove entirely efficacious. Should it do so, its application will undoubtedly solve one of the knottiest nautical problems of the day.

The Ascent of Kilimanjaro.

DR. HANS MEYER read before the Royal Geographical Society an account of his recent expedition to the summit of the great African mountain, Kilimanjaro, in the course of which he said that in Africa, as in other parts of the world, the energy of volcanic forces appeared to have attained its maximum in the equatorial regions. Within these the peak of Ruwenzori towered up 17,400 feet above the sea, Kenia rose to a height of 19,000, and Kibo, the highest summit of Kilimanjaro, attained 19,700. Kilimanjaro was thus the loftiest mountain within the limits of Africa. He and his companion, Herr Purtscheller, at an altitude of 19,000 feet, found the oxygen of the air amounted to only 40 per cent., and the humidity to 15 per cent. of what it is at the sea-level. The surface of the ice from this point became increasingly corroded. They frequently broke through as far as their breasts, causing their strength to diminish with alarming rapidity. And still the highest ridge of ice appeared to be as distant as ever. At last, about two o'clock, after eleven hours' climb, they drew near the summit of the ridge, and then the secret of Kibo lay unveiled. Taking in the whole of Upper Kibo, the precipitous walls of a gigantic crater yawned beneath. A further ascent brought them to the foot of the highest three pinnacles, which were climbed one after another. The central pinnacle reached a height of about 19,700 feet, overtopping the others by 50 to 60 feet. He planted a small German flag upon the ragged lava summit, and christened this—the loftiest spot in Africa—Kaiser Wilhelm's Peak. After having completed the necessary measurements they were free to devote attention to the crater of Kibo. The diameter of the crater measured about 6,500 feet, and it sank down some 600 feet in depth. In the southern portion the walls of lava were either of an ash-grey or reddish-brown colour, and were entirely free from ice, descending almost perpendicularly to the base of the crater; and in its northern half the ice sloped downwards from the upper brim of the crater in terraces, forming blue and white galleries of varying steepness. A rounded cone of eruption, composed of brown ashes and lava, rose in the north portion of the crater to a height of about 500 feet, which was partly covered by the more than usually thick sheet of ice extending from the northern brim of the crater. The large crater opened westwards in a wide cleft, through which the melting water flowed, and the ice lying upon the western part of the crater and the inner walls issued in the form of a glacier. Subsequently, they made their way to the central peak of Mawenzi, the eastern summit of Kilimanjaro, by three separate ascents. The characteristic feature of Mawenzi was its tremendously jagged surface, the denudation of its lava rock having penetrated to the very heart of the mountain, and given birth to stupendous walls and precipices, which radiated from a central crest running north and south, and were joined at their distant bases to each other by mounds of detritus. In the west of the mountain the tali of lava detritus, showing the greatest variety of form and colour, and a perfect Paradise for mineralogists and petrographers, sloped gently out on to the elevated saddle stretching over to Kibo. On the eastern side, however, the mountain, from an altitude of about 17,050 feet, descended with dizzy abruptness for some 6,500 feet into a huge ravined cauldron of erosion, from which it continued down to the level of the plain, in far-reaching and symmetrical slopes, for another 8,200 feet. The feathered denizens of the air were represented on the saddle plateau by a slender and lively stonechat, and by a swift species of rock

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swallow, which built its nest on the lava hillocks of the plateau. They fed upon several varieties of beetles, wasps, and flies, which swarmed as far as the flowering plants extended, and on a small black spider, which lived far away up in the volcanic cinders. The antelopes could ascend from the northern face of Kilimanjaro as far as the saddle without let or hindrance. The travellers afterwards proceeded down the primeval forests covering the southern slopes of Kilimanjaro, and, having crossed the rivers Ngombere and Weriweri, they soon reached Majame, at the western base of the mountain, at an altitude of 4,600 feet. There they surveyed the western and southern parts of Kilimanjaro, the results fully rewarding all their trouble.

Notes on Sir William Thomson's Electric Measuring Instruments.*

By Charles H. Yeaman.

THE instruments which owe their birth to the prolific genius of Professor Sir William Thomson may be roughly classified as follows :—

1. Those requiring no current. 2. Those requiring current.

Section 2 may be divided into those of the galvanometer class (A), those of the dynamometer class (B), those of the solenoid and core class (C).

In the limits of this paper the supplementary instruments, such as Rheostats, the new volta-pile, Rheostatic machine, or the various methods employed in calibrating, restandardizing or testing, and the electrometers belonging to no special series or chain, such as the absolute, the portable, and the long-range instruments, cannot be even mentioned.

The Electrometer, being an instrument which usually is based on the principles of static attraction, can be applied to measure differences of potential between different points of a wire or metallic mass of any shape in which electricity is kept flowing by a battery or dynamo, or other electromotive apparatus.

This instrument, however, has the objection of being a condenser, and possesses a capacity, and, occasionally when used with alternate or reversed currents now becoming so common for long distance electric lighting, this causes a very sensible change in its indications from what one has good reason to expect. The electrometer, as a potential difference meter for continuous current measurements, is ideally perfect, and Sir William has, after many difficulties and years of experiment, been able to place an electrostatic voltmeter on the market to read as low as 25 volts.

The Quadrant Electrometer, with which nearly everyone is well acquainted, is purely a laboratory instrument, and it does not read volts but gives deflections which are constantly varying, and are only of use when it is in the hands of trained individuals.

The quadrant electrometer is the finest of a chain of instruments which bids fair to displace all others as Standards, that is to say, instruments not in practical use themselves but used to correct the working gauges. The quadrant has a range of from $\frac{1}{100}$ volt up to about the lowest reading of the next instrument of the series, which is the multicellular electrostatic voltmeter, beginning at 25 volts. The quadrant electrometer consists of a cylindrical brass box, divided so as to form four quadrantal sectors, which are supported by means of glass legs. The opposite pairs of these are connected, and inside the hollow system hangs a dumb-bell-shaped needle by a bifilar suspension formed of two parallel silk fibres. The needle and one set of quadrants are connected to one pole of the generator, or one point of the pair between which the potential difference is to be measured, and the other set of quadrants is connected to the other point. Thus we have practically an air condenser, with one of its plates capable of a to and fro motion, so as to vary the capacity of the condenser, and the moveable plate always tends to move so as to make that value a maximum. The angular movement of the needle is shown on a scale by the usual method of reflection of a beam of light from a mirror attached to the needle. This gives us the means of measuring P.D.'s from ·01 to 25 volts, where the range of the lowest of the multicellular instruments joins the quadrant. The principle remains the same, but instead of one cell or set of sectors, and a single moveable vane or needle, there are several. In the case of the quadrant electrometer, the force of attraction tending to rotate the moveable plate or needle is balanced by the twist of the bifilar suspension before mentioned; in the multicellulars this force is exerted against the torsion of the suspending wires.

As the Multicellular is the newest of the individuals composing the chain, it may be well to describe it rather fully. The insulated cells, or sectors, are formed of triangular brass plates fixed into saw cuts in a brass back-piece so as to be equal distances apart and accurately parallel to each other. Two sets of these cells are fixed relatively opposite to each other by a vulcanite sole plate. The whole system of cells and a set of vanes suspended so that they are horizontal, and that each is in a plane exactly midway between those of two contiguous condenser plates. Like all Sir Wm. Thomson's instruments, where it is possible to increase the portability of the instrument, a small thumb-screw is placed in the centre of the base plate below the instrument, which can be screwed in so as to lift the weight of the spindle and vanes from the suspending wire. At the top end of the spindle carrying the needles, or vanes, is attached an aluminium needle, which indicates on the horizontal circular scale fixed in the scale box, the difference of potential between the moveable and fixed portions of the condenser by direct readings in volts.

These instruments have a range of from 1 to 4½, and the best of the scale lies between the limits of 1 to 2½, the centers coinciding in most cases. The highest reading obtainable on a Multicellular is 800 volts, and with the greatest accuracy 600, but already the lower limit of the vertical scale voltmeters has become available. Beginning at 400 volts, and finding their maximum at 12,000, the vertical scale instruments with their latest improvements render the measurement of an E.M.F. of the values within reach of these powers a very easy matter, as well as assuring a high percentage accuracy.

The Electrostatic Balance. This instrument consists of a steelyard carrying one plate of the condenser and having a limited travel over a scale divided into 50 divisions, the value of a division being dependent on the weight hung on the arm, giving either 250, 500, or 1000 volts per division. The fixed plate consists of a brass disc supported from a slate base plate by means of the Thomson "hole, slot and plane" arrangement whereby the position of the disc is always fixed with relation to the other details. A brass case fits upon the slate base plate with a glass front which contains the indicator and scale. The moveable part is a square aluminium plate supported by two long links which pass through a slit in the top plate of the case to two knife-edge stirrups on one end of the counterpoised indicator.

The range of electrostatic measurement for ordinary practical purposes by the chain of instruments already described is complete from $\frac{1}{100}$ to 50,000 volts. Little difficulty would be experienced in making an instrument, were it desired, to suit higher ranges, the problem of finding a convenient electrostatic instrument to give direct readings of potential below 50 volts is more difficult. A voltmeter of the multicellular type might be made with a lower range but in order to do so the length of the suspension and the mass of the vanes would probably be increased to such an extent as to render the instrument clumsy, and at the same time difficult to observe, owing to the long period of vibration of the indicator.

* *Abstract of paper read before the Liverpool Physical Society, Jan. 20th, 1896.*

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These instruments all belong to the idiostatic system of electrometers, that is, that in which the whole electric force depend on the electrification which is itself the subject of the test, in contradistinction to the class in which besides the electrification to be tested another electrification maintained independently of it is taken advantage of, or, in short, the heterostatic system.

A very neat design for an electrometer after the Thomson pattern is due to Mr. Wright, of the London Electric Supply Corporation, and physicists have rather fancied the general type of instrument. Open-circuit instruments, of course, like the electrostatic, are only capable of being used as voltmeters, unless we use them to determine current values indirectly by means of known resistances. On the other hand though closed circuit instruments can alone measure current, since they are at constant temperature of a fixed resistance, the current flowing through them will be proportional to the P.D. across their terminals, and as they measure that current they may therefore indirectly, theoretically put in practice directly, give that value in volts on a scale calibrated by experiment. Therefore in considering E.M.F. or current measurements we may discuss the type of instrument within certain limits without being at all particular as to the winding of the meter, basing our arguments simply on its design and constructional details.

To Sir Wm. Thomson we owe a debt of gratitude for the beautiful and trustworthy MIRROR GALVANOMETER first brought out 31 years ago. Sir William has succeeded in measuring as low as one-fifty millionth of a milliampere or a figure of merit of fifty thousand millions with a coil of from 5000 to 10,000 ohms. This instrument depends upon a magnetized needle as the indicator, whereby the magnetization of the of the coil core is compared to that of the earth at that place, and it is therefore essentially magnetostatic.

Sixteen or seventeen years ago the "paddle-wheel" galvanometer was introduced. In this instrument two coils, somewhat like the paddles of a steamer, adjustable to any desired equal distance on the two sides of the centre action, a small needle or group of needles hung by a single silk fibre and carrying a pointer of about 8 centimetres length, which showed the deflections on a scale of tangent divisions.

This was displaced by the graded current and potential meters, which did good work, and were capable of considerable accuracy in a locality free from local magnetic disturbance. These instruments consisted of three separate parts, the coil of wire producing the test field, the magnetometer box and scale, with its controlling magnet giving an indication of the rates of the fields and the platform carrying the coil, and forming a base on which the magnetometer slid.

The last of this series of magneto-static or galvanometric instruments is the MAGNETO-STATIC LAMP COUNTER, which is a very simple form of permanent-magnet controlled tangent galvanometer, with a skew tangent scale. The controlling magnet has vertical play, but can be clamped at any point, thus we have a means of varying to constant of the lamp counter before setting it to what is intended as one lamp per division. The needle is a light steel disc swinging freely in a closed glass tube, the suspension being made by a very short fibre of silk, aided by a platinoid miniature coach spring. Two D shaped coils of copper strap, one on each side of the magnet, place it in the centre of a field in opposition to that of the controlling magnet, and the new position the steel disc magnet and along with it the aluminium pointer takes up gives the ratio of the one to the other. This instrument has a range of 1 to 100, and an accuracy of ¼% as an average throughout its scale.

The next class of instruments are those of the dynamometric type, and it would be a fitting start to take the SIPHON RECORDER coil, which has now become the modern Depeiz D'Arsonval galvanometer. In the first form, two large electro-magnets had their axes horizontal, and in the same straight line the poles about ¾ apart. In this space there hung a light and delicate coil of copper wire insulated with silk.

This is now altered by substituting permanent magnets for those that require a powerful battery of Thomson Tray cells to excite them, and the motion of the coil is shown by the usual lamp, ray of light, and scale arrangement. The chief recommendation of the new arrangement is that it is unaffected by moving masses of metal or abrupt changes of local magnetism.

About 1886 Sir Wm. Thomson took up the dynamometric principle and constructed some instruments with a set of weights held off cross-bars by means of finger pins, while at the other end of what, little more than a complicated bell crank lever, was a large coil moving outside of and around a solenoid. The connections were made by the Siemens method of mercury cups, but neither the vertical arrangement of attracting coils, nor the weights, nor even the mercury now remains. Instead of all this there is a beautiful arrangement of a sliding weight and self-releasing carrier of double sets of a dynamic horizontal coils, and a ligamentary suspension that is decidedly the best thing in its line.

There remains yet one off-shoot from this branch to be mentioned, and that is the ENGINE-ROOM VOLT INDICATOR and the new VOLT GAUGE, which are one in principle, though slightly varied in design; they have a short range and are direct reading without any adjustment. The desirability of obtaining a voltmeter which should be free from springs, permanent and electro-magnets, led to the design of a steelyard voltmeter, for use within a certain range. A long, light arm of aluminium was balanced like a steelyard on knife-edges of phosphor-bronze resting on glass plates. At one end of this arm was suspended a very small cylinder of soft iron, about 5 min. diameter and about 8 min. long, and below this a balance weight of copper. The iron cylinder hung in the interior of a small coil of fine wire having a resistance of 200 ohms, and wound more thickly with turns of wire at the top than at the bottom. The iron core hung near the bottom open end of this coil. When the current passed through this coil it produced in the interior a magnetic field which was stronger near the top than at the bottom of the interior of the coil. The little cylinder of iron was accordingly moved up from weak to strong places in the field in opposition to gravity, and for every given current in the coil, there was, within certain limits, a coresponding place of equilibrium for the iron, and therefore, position for the steelyard arm. The steelyard arm moved over a scale which was directly marked in volts, and when the terminals of the instrument were attached to any conductor, between which a P.D. was maintained, the instrument gave at once the value in volts. In order to give the instrument a sufficiently high resistance there was a coil of platinoid wire attached in series to the working coil, and which had a resistance of 2000 ohms. There was also attached a current reverser, by means of which the current in the coil could be rapidly reversed and any traces of remnant magnetism got rid of from the iron. In this apparatus the force with which a small piece of iron tended to move from weak to strong places in the magnetic field was weighed against the constant force of gravity.

Museum Notes.

THE new Ruskin Museum at Meersbrook Hall, Sheffield, was opened on April 16th by the Earl of Carlisle. For some years the collections have been housed at Walkley, a suburb of Sheffield, but the Corporation, having recently acquired this more central and suitable piece of ground, offered to Mr. Ruskin, of the St. George's Guild, the use of Meersbrook Hall, on condition that the collections should remain at Sheffield for twenty years at least. The museum contains specimens of the most beautiful art work in existence, and an exceedingly choice collection of gems and precious stones, selected by Mr. Ruskin. A very large gathering of guests took part in the opening ceremony, over 1300 invitations having been issued for the occasion. Owing to his ill health, Mr. Ruskin was not able to be present.

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MR. EDGAR R. WAITE, sub-curator of the Museum of the Leeds Philosophical and Literary Society, has just been elected a Fellow of the Linnæan Society of London.

THE final lectures of the winter course at the Liverpool Museum have been given by Mr. J. Chard on "Spiders," and by Mr. R. Paden on "Animals and their Uses." (Parts 1 and 2.) During the winter months 26 lectures have been given, and the attendance on the Monday evenings when the museum was open to the public has reached a total of 8,368.

IT is understood that in view of the probable sale of the world-renowned Middlehill Library at Cheltenham, which was formed early in the present century by Sir Thomas Phillipps, the British Museum and the Universities of Oxford and Cambridge have agreed to unite in securing those manuscripts which it is thought of importance to retain in this country.

ON Easter Monday a "holiday lecture" was given at Owens College museum, at Manchester, by Mr. W. E. Hoyle, keeper of the museum, on the subject of "Wings." The lecturer dealt with the wings of insects, fish, birds and mammals, describing the structure of the wing in its stages of rudimentary and perfect development, and illustrated his remarks by means of lantern slides and by actual examples from the museum casns.

THE Museum at Pompeii has obtained two plaster casts of the bodies of a man and a woman, taken from impressions made in a stratum of volcanic ash outside the Stabian Gate. From some accompanying impressions of a tree, with foliage and fruit (a variety of *Laurus nobilis*, the round berries of which ripen in late autumn), it seems probable that the destruction of Pompeii, after the memorable eruption of A.D. 79, took place in the month of November, not in August, as has been supposed.

IN the British Museum a general redisposition of its antiquities is taking place. In the Archaic Room the pediments are being set up for the Egina marbles, and the contents of the Elgin Room are being displayed with better effect. In the Egyptian Gallery the latest addition is the palm-leaf pillar presented by the Egypt Exploration Committee. In the Mummy Room the walls above the cases have been decorated by casts of Egyptian monuments, and at the end of the series of rooms a painting has been placed—enlarged from a papyrus—representing the Judgment of the Dead. Further, in the Prehistoric Room, at the top of the grand stairs, the whole of the famous Christie collection is at last displayed. In the Ethnographical Galleries there are some recent additions of photographs from the late Paris Exhibition.

BOOTLE FREE LIBRARY AND MUSEUM.—The third general report of the Free Library and Museum Committee for this borough for the year ending 25th March attests the continued and growing success of the institutions under their charge. There has been an increase of 8,000 works issued from the library, bringing the year's outgo for home reading and reference to more than 50,000 volumes. The well-thumbed appearance of books on engineering and other technical works, for which there is a good demand, is noticed with gratification, although, of course, by far the larger number of books issued belong to the category of prose fiction. There has been a falling-off in the number of visits to the museum and reading-room, the total number of visitors to the former having been nearly 8,500, and to the latter 182,000. It should, however, be mentioned that the museum was entirely or partially closed to the public for a considerable time, owing to a hospital bazaar last May. The museum addresses have been continued, and the science classes, under the joint control of this committee and that of the Liverpool Science and Art Classes, have been increased in number. The free popular lectures were increased in number during the past season. Small fresh water aquaria were exhibited in the museum during the summer months. The Curator (Mr. J. J. Ogle) is preparing a "Guide to the Birds in the Museum" for publication at an early date. Several objects have been lent to teachers for the illustration of lessons, and every effort has been made to render the collections useful to students and others.

THE visitors on Easter Monday to the British Museum numbered 10,942, at the Natural History Museum 12,824, and at South Kensington 20,161.

THERE is unusual satisfaction in seeing the marked advance made in the Natural History Museum at South Kensington towards completeness of arrangement. Especially noticeable is the completeness of the geological department. The arrangement of the mammalia, reptilia, and fishes is finished; and of the immense division of invertebrata, the sponges and corals, the brachipoda, the echinodermata, and the mollusca are fully displayed. The cephalopoda are also very far advanced. The whole series is first divided off into stratigraphical divisions, and in each of these a zoological classification is followed; so that if it be desired to select any geological division, such as the Neocomian, therein will be found its characteristic organic remains. Or if it be wished to follow the time-history of any zoological family, by passing from one case to another in line, the genus or family investigated will be traced through its geological existence. The British specimens occupy the central table cases; the foreign examples are located in the wall cases.

THE annual report of the Bristol Museum and Library for 1889 states that the record of the past year has been uneventful, but that the general condition of the institution is satisfactory. Several important additions to the museum have been made. They include a series of eighty-two vases, mostly terra-cotta, collected by the late Sir J. Dorney Harding from ancient Greek tombs near Corinth; a colossal head in red granite of the Egyptian god Osiris from Bubastes, *circa* 1400 B.C., and other objects presented by the Egypt Exploration Fund; and several specimens of animals presented by the Clifton Zoological Society. About two hundred of the series of Secondary and Tertiary fossils received as "exchanges" from the British Museum have been mounted and placed in cases. It is interesting to note, as testifying to the use which is made of the museum by working naturalists, that several geologists of note have been supplied with information relative to the contents of the museum, which was needed by them for the pursuit of investigations in which they are engaged.

THE inaugural meeting of the Museums Association (formed at York last year) will be held at Liverpool on the 17th, 18th, and 19th of June. The objects of the association are summarized as follows:—(1) Means of interchange of duplicate and surplus specimens; (2) Securing casts, models, &c.; (3) Scheme for general supply of labels and information; (4) Indexing the general contents of museums; (5) Popular lectures; (6) Educational loan collections; (7) Concerted action for securing government publications; (8) Issue of a museum journal. A strong local committee has been formed to arrange for the reception of the visitors. The proceedings will open on the evening of Tuesday, 17th June, with an address by the President, the Rev. H. H. Higgins, M.A., which will be delivered in the lecture theatre of the Liverpool Free Public Museum. Wednesday and part of Thursday will be devoted to the reading and discussion of papers, and excursions will be arranged during the visit to local museums and other places of interest. Messrs. T. J. Moore, Cor. Mem. Z.S. (Liverpool), and H. M. Platnauer (York), are the general secretaries. Mr. R. Paden (Free Public Museum) and Mr. H. A. Tobias (Brompton Avenue, Liverpool), have been appointed local secretaries; and Mr. A. J. Bamford (20, Cheapside, Liverpool), treasurer.

Biologists at Puffin Island.

TAKING advantage of the Easter vacation, several members of the Liverpool Marine Biology Committee proceeded to Puffin Island to re-open the station for the season's work. Mr. Isaac C. Thompson, F.L.S. (who accompanied the party), has written an account of the visit, in which he reports that the advantages offered by the full moon and very low spring tides were largely availed of for dredging and tow-netting, and for shore collecting in the numerous tidal pools. Experiments conducted during last season on board the "Hyæna" have shown the value of the electric light as a means of attracting marine crustaceans and other animals into the tow-nets, in which the lights were suspended.

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Moonlight similarly attracts numerous animals to the surface, and a sail round the island with a tow-net towed to the stern of the boat yielded some good captures. They consisted chiefly of microscopical crustacea, amphipoda, copepoda, and cirrepedia, with a large number of *sygitta cipunctata*, a ferocious-looking scavenger animal, allied to the worms, and frequenting the surface of the sea, especially at night. The free-swimming microscopical ascidian, *appendicularia*, a tadpole-like animal, with a long thin tail, by which it propels its way through the water, also revealed itself when a sample of the gathering was placed under the laboratory microscopes.

The low tide shore collecting proved very successful, and with the small punt and a smooth sea the biologists were able to explore some of the rocky caves on the north side of the island. A visit to the rocks, upon which the Beacon light stands in the centre of the "race" separating Puffin Island from the mainland of Anglesey, revealed unexpected treasures. Here the deep fissures between the large rocks were literally covered with the large compound polype, *alcyonium digitatum*, commonly known as the dead man's finger, and with it the beautiful zoophyte, *tubularia indivisa*, with a head like a lovely pink flower, formerly found on the under side of the pontoons of the Liverpool Landing Stage, and still common at Hilbre Island. Under every stone was to be found the flat-clawed crab, *porcellana platycheles*, and brilliantly-coloured worms wriggled out of their secret hiding-places. The variously-coloured ascidian, *botryllus*, and the elegant pink coral, *corallina officinalis*, were obtained at the lowest points. The dredging party brought up a large variety of zoophytes, including the rare *garcia nutans*, numbers of the wriggling, brittle star, *ophiothrix pentaphyllum*, the glistening, transparent, globular ctenophoran, *pleurobachia pileus*, and amongst the larger crustacea several specimens of the spider crabs, *stenorhynchus*, and the fairy shrimps, *caprella*. A novel experiment in tow-netting was put into execution, viz., that of leaving a tow-net attached to a deep sea buoy. The strong tide kept it extended near the surface, and on returning to it next day the party were rewarded by finding a rich haul of microscopical marine life.

Puffin Island wears a continual change of outward apparel in its garb of vegetation at different seasons. The puffins had not yet returned from their winter home on the Atlantic. Gulls, cormorants, guillemots, and oyster catchers were found about the rocks in vast numbers.

Our Portrait Gallery.

XXI.—WILLIAM PENGELLY, F.R.S., F.G.S.

FEW among those who are regular visitors at the annual meetings of the British Association are unacquainted with the tall form and genial presence of Mr. WILLIAM PENGELLY, who for so long a period has been identified with the history of cave exploration in Britain. Following up the well-known researches of the late Dean Buckland, Mr. PENGELLY has given most valuable practical aid in those investigations which lie on the borderland between geological and archæological science But the science of Cave-hunting (to use Professor Boyd Dawkins' happy expression), has advanced greatly beyond its pristine limits since the days of Buckland, when men's minds were filled with ideas of a universal deluge as a *vera causa* of the later geological phenomena. Largely by the efforts of Mr. PENGELLY and the astonishing enthusiasm with which he entered into the work of exploration himself and induced others to aid in the same spirit, we have arrived at a better understanding not only of the nature of the deposits found in the limestone caverns of Great Britain, but also of the real extent of geological time during the periods of which the strange record is revealed by the caves and their contents.

There is no more exciting narrative in the entire history of geological discovery than the accounts which Mr. PENGELLY has given us of the successive occupation of Kent's Cavern by wild and extinct quadrupeds, and by races of men further removed in civilization from those of our own day than is often recognised. The element of chronology—that great stumbling-block with many who think that geologic time can be computed in years or centuries—is dealt with by Mr. PENGELLY in language which cannot be mistaken as indicating the actual remoteness of the epoch of the cave-men of Britain, and his patient review of the different classes of evidence from which he draws his conclusions affords a proof, were any needed, of the careful thought which he has bestowed on each inquiry, however minute or however laborious. The guiding principle in scientific investigation is the application of strict logic to accurate observation. The student of pre-historic archæology, or, indeed, any branch of science, can apply to his work the advice given by Mr. PENGELLY:—"Be careful in scientific inquiries," he writes, "that you get a sufficient number of perfectly trustworthy facts; that you interpret them with the aid of a rigorous logic; that on suitable occasions you have courage enough to avow your convictions, and don't be impatient or annoyed if your friends don't receive all your conclusions, or even if they call you hard names." The experiences alluded to in this quotation have probably fallen to the lot of most seekers after truth who, untrammelled by traditions of the past, have determined to strike out in original lines of thought.

WILLIAM PENGELLY was born at East Looe, a village in Cornwall, on January 12th, 1812. From early life he developed a taste for natural history, and was soon attracted by the remarkable discoveries of Mr. Northmore, the Rev. John McEnery, and others at Kent's Cavern, near Torquay. Geological studies always had a charm for him, and, in addition to his long-continued exploration of bone-caves, with an ardour such as few others have shown, Mr. PENGELLY has contributed largely to important work in other branches of the science. He is the author of numerous treatises on the Devonian and Triassic rocks of Devonshire, on St. Michael's Mount, on the Cromer forest bed, and on many other geological subjects. In conjunction with Dr. Heer, of Zurich, he produced a monograph on *The Lignites of Bovey Tracey*, published in 1863, which is regarded as a classic. His assiduity in the collection and arrangement of specimens is testified by the magnificent series of Devonian fossils which,

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WILLIAM PENGELLY, F.R.S., F.G.S.

From a Photograph by H. J. Whitlock, Birmingham.

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under the title of the "Pengelly Collection," were lodged in the Museum of Oxford University by the Baroness Burdett-Coutts, in connection with the Burdett-Coutts Geological Scholarship. He was elected Fellow of the Geological Society in the year 1850. Mr. PENGELLY has also received the well-won distinction of election as a Fellow of the Royal Society.

For many years past he has lived at Torquay, in the vicinity of the caves, whose recesses have been almost daily visited by him, no work of exploration having been carried on there without his presence and valued advice.

Mr. PENGELLY has ever been eager to foster a love for science among the people, and to encourage studies which have for their object the advancement of scientific knowledge. He was instrumental in establishing in 1837 the Torquay Mechanics' Institute. Seven years later, he originated the Torquay Natural History Society, and in 1862 he founded the Devonshire Association for the Advancement of Science, Literature, and Art, of which he was President for the year 1867-8, taking, ever since their inception, an active part in the management of these institutions.

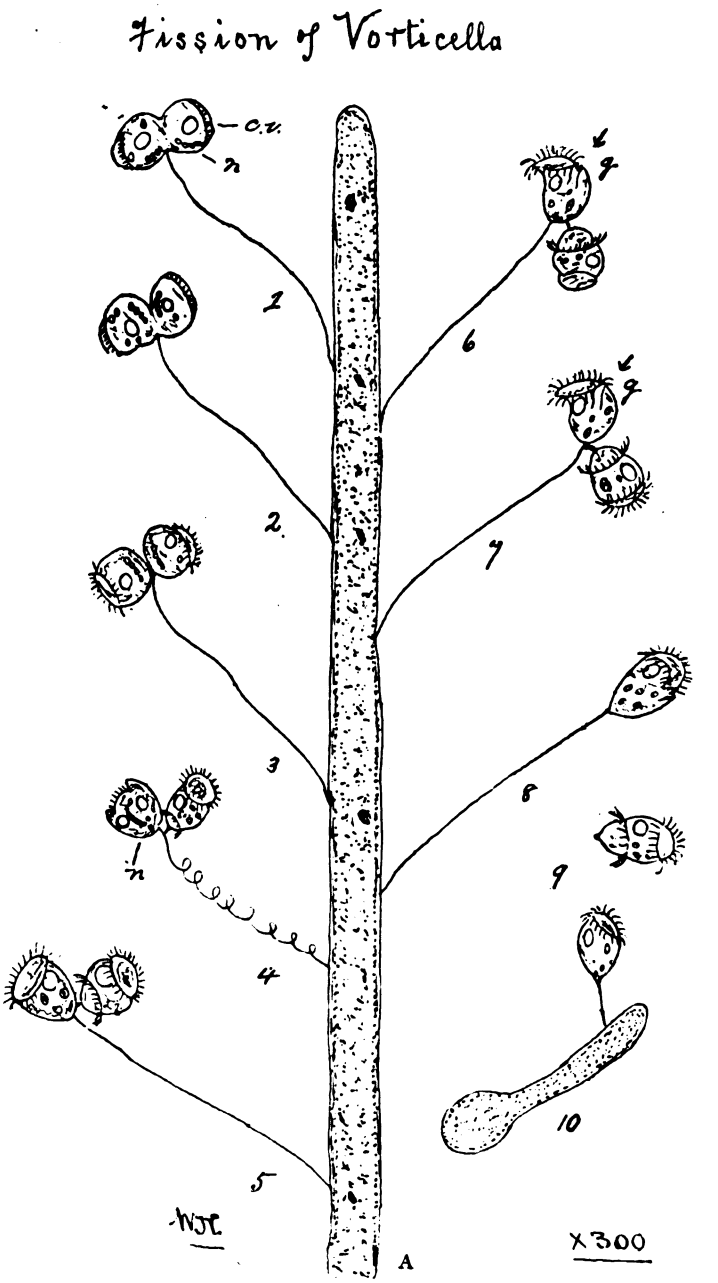
Much of Mr. PENGELLY's time has been spent in the actual labour of disinterring cave remains and exploring these early rocky domiciles of pre-historic man. The general public will, however, have a keen recollection of his appearance as a lecturer some years ago, when he delivered in several of the principal towns of England some popular discourses on the subject of his favourite reseaches. The lectures on "Kent's Cavern," and "On the Time which has Elapsed since the Era of the Cave Men of Devonshire," excited universal attention, and will be held in memory for their clearness of style and simplicity of exposition, no less than for the interest of the graphic picture of early man and his surroundings which the lecturer drew. His discourses were relieved by little personal touches, which at once brought him *en rapport* with his audience.

All Mr. PENGELLY's work is marked by an enthusiastic devotion, which acts as the best incentive in the spread of scientific knowledge. O. W. J.

A Note on the Fission of Vorticella.*

BY WM. NARRAMORE, F.L.S.

THIS always interesting and instructive infusorian has been the subject of much writing, and the fairy-like stories told by popular writers have surrounded the lowly organism with a kind of halo of fascination. I have no special wonder to relate, but a simple, plain story of an hour's observation of the longitudinal fission of vorticella. This infusorian is not restricted to either time or place; any season of the year it may be found, and in almost all waters containing decomposing organic matter. To see vorticella to perfection, gather some submerged sticks and leaves from a pond with overhanging trees, or examine the submerged leaves of the water-ranunculus, when these objects are thickly furred with a light-looking flocculent fringe; now myriads of these active, gyrating, spiral-forming, contracting, expanding, freely-ciliated bells will be found. As one watches this bewildering mass of living atoms all stages of division will be observed. It was with such a picture before me that I managed to keep the eyes fixed on one vorticella, and for about one brief hour watched it through the several stages of fission.



A. Filament of Vaucheria; *c.v.* Contractile vesicle; *n.* Nucleus; *g.* Gullet.

Fig. 1 presents the first appearance; the animal whilst standing straight on its stalk expands a little laterally, and the slight depression in the centre is the first indication of division. No difference in the size of each is observable, the ciliated peristome is turned in, and a part of it now appears in each half, the cilia very slightly active, a contractile vesicle plainly visible in each, also a few food vacuoles, and a short line of aggregated particles, which doubtless represents the divided nucleus.

* Read before the Liverpool Microscopical Society, March, 1890.

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Careful observation only barely revealed a most gradual incision, which in the space of ten minutes had penetrated about half-way through.

In *fig. 2* the ciliated peristome of the right hand figure, which we must regard as the offspring or daughter vorticella, is still rolled in, whilst that of the parent bell everted, and the cilia actively vibrating; contractile vesicle, food vacuoles, and nucleus as seen in *fig. 1*.

Fig. 3 shows the condition of things in another five minutes. The incision has now completed the bisection, no internal change noticeable, the newly-formed vorticella appears to be sharing with its parent one half of the apex of the stalk; the peristome of each is now everted. In another three minutes follows the appearance of things in *fig. 4*, where the daughter is seen to be fixed at right angles to the base of the parent bell by a diminutive stalk; the peristome fully expanded and cilia very active, contractile vesicle and food vacuoles obvious; the parent bell remains very erect with peristome partly rolled in, and the elongated nucleus quite distinct. At this stage a new structure makes its advent at the base of the daughter vorticella. This is of the nature of a finely-developed band of exceedingly delicate cilia. Both bells become more restless than before; the stalk now exhibits its retractile function, and again and again the vorticellæ are drawn in and as quickly expanded. In another five minutes it was observed that the basal band of cilia had considerably developed, and now appears as a very strong circlet. *Fig. 5*. The daughter bell during its vigorous action had slightly shifted his position from the apex of the parent stalk, and now appears at the side of the base of the parent bell.

Fig. 6, taken at an interval of another five minutes, shows both vorticellæ injesting food freely; the oral aperture and gullet were plainly seen with the food vacuoles forming at the bottom of the gullet. Contraction of the stalk frequent, and the parent bell significantly turned away from the daughter bell. This position maintained for the next fifteen minutes, as seen in *fig. 7*, and in this figure it will be observed that the tiny stalk of the daughter bell is attached to the apex of the parent stalk. This most likely is the true position, the vigorous motion making it to appear to be attached a little higher up. For the following ten minutes considerable activity prevailed; in the case of the parent food was freely drawn into the mouth and gullet and quickly injected, whilst the daughter bell, now twisting and turning, now ceasing for a moment as if to gather strength for the final effort. The moment of divorce has come, the gradually attenuated thread of protoplasm is snapped, and the young inexperienced child is adrift on the troublous waters of life. Free from the restraints of stalk and parental authority, with the true instinct of freedom, it performs at first a whole series of frantic rotary movements aided by both circlets of celia, then a dash hither and a plunge thither, and in a moment longer, the field of the microscope being too confined, our child is lost to sight, and *(fig. 8.)* stands a solitary witness to the great transaction—*fig. 9*, free bell.

A few minutes later and there is observed in another part of the field seated alone on the dark-green extremity of a developing *Vaucheria* tube a short-stalked vorticella *(fig. 10)*. I do not with certainty identify this as the lost child, but we may assuredly assert the active life of the freed vorticella is soon brought to an end. The secondary or basal circlet of cilia disappears, the bell settles to a sedentary life, and developes a stalk. Now it is quite evident that the basal circlet of cilia is a development required for locomotion. It rapidly appears as soon as fission is completed; remains active as long as the vorticella lives a free life, but as soon as the organism settles down the basal band as rapidly disappears. The anterior circlet of cilia being of service in gathering in food is of necessity a permanent structure. The oral aperture and the gullet quickly appear as soon as fission has taken place. This again is a necessity, for these organisms live to eat, and growth is rapid. The progeny soon arrive at the adult condition, which is evident from the fact that one seldom observes much if any difference in size of the same species of vorticella; of course the point is not easily determined because of the minute size of the organism.

The contractile vesicle and the nucleus appear to divide before the fission of the bell reaches these structures; the former rapidly takes up a central position in each half of the bell, whilst the nucleus at first appears to be composed of aggregated particles of slightly-differentiated protoplasm.

Notes in Brief.

THE convention of photographic societies of Great Britain will be held at Chester during the last week of June. Among other attractions, special facilities not hitherto allowed to amateurs will be granted by the Duke of Westminster for photographing both the exterior and interior of Eaton Hall.

IT is contemplated to hold a photographic exhibition in Liverpool, in the spring of 1891. The exhibition is to be open for the term of one month, and the same splendid apartments in the Walker Art Gallery as were used for the exhibition of 1888 will be granted on this occasion.

ZIGZAG FORM OF LIGHTNING.—Mr. E. S. Bruce, M.A., states his belief that the zigzag form of lightning is an optical reality, and not merely a fancy portrait. He maintains that the clouds on which the flash is projected are often of a cumulus type, and produce an angular reflection. In general, however, the flash must be considered as a meandering stream.

AT a recent meeting of the Geological Society of London, a human skull, found in a bed of sand 27 feet below the surface in the Manchester Ship Canal excavations, was exhibited. The skull, which, though not remarkable in shape, seemed from its appearance to be of considerable age. It was found in a bed of fine sand beneath a deposit of blue silt (3½ feet), overlain by red clay (6 feet).

A PARTY of nine explorers is to start from Denmark this summer under the command of a naval lieutenant, Herr Ryder, in order to explore the eastern coast and interior of Greenland. The expedition will be rationed for two years, and be accompanied by three boats with sledges for winter travelling. A steamer will take the men out, and fetch them away again. The project is popular in Copenhagen, and the estimated cost is about £16,000.

THE following graphic description of a struggle between some gulls and an eagle is given in the *Newcastle Chronicle*, by Mr. Drosier, of Norfolk:—"As I was intently observing the majestic flight of the eagle, on a sudden he altered his direction, and descended hurriedly, as if in the act of pouncing; in a moment five or six of the skuas passed over my head with an astounding rapidity; their wings partly closed, and perfectly steady, without the slightest waver or irregularity. They soon came up with the eagle, and a desperate engagement ensued. The short bark of the eagle was clearly to be heard above the cry of the skua, who never ventured to attack his enemy in front; but taking a short circle round him until his head and tail were in a direct line, the gull made a desperate sweep or stoop, and striking the eagle on his back, he darted up again almost perpendicularly; when, falling in the rear, he resumed his cowardly attack. Three or four of these birds thus passing in quick succession, harrassed the eagle most unmercifully. If, however, he turned his head, the gull quickly ascended without touching him. This engagement continued for some time, the eagle turning, and wheeling as quick as his ponderous wings would allow, and when he approached some rocks, the gulls made off."

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IT is announced that the *Araucaria imbricta* has been naturalised in France on an estate at Penandre, about 10 miles from Brest. The trees form a veritable virgin forest, growing to a height of 90 feet, the diameter of some of the trunks being about three feet.

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THE Committee of the Society for the Protection of Ancient Buildings, having heard with regret of the mutilation of some of the ancient monuments of Egyptian art, has expressed to the Egyptian Government the hope that they will take steps to prevent the recurrence of such an irreparable misfortune.

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MR. J. SEYMOUR ST. JOHN has in the press a handbook to the Larvæ of the British Macro-Lepidoptera and their food-plants, both in nature and in confinement. A work of this nature has long been wanted by entomologists. The volume, which will be of handy, pocket size, may be obtained from the author, 42, Castlewood Road, Stamford Hill, London, N.

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PROFESSOR MARSH, the leading American palæontologist, has discovered a new pre-historic monster in the upper cretaceous deposits of the eastern slope of the Rocky Mountains. The skull of this animal is over eight feet long, and is powerfully armed with a pair of horns on the top, a sharp beak in front, and a protuberance above the nose. There is also a row of sharp projections round the margin of the posterior crest.

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THERE is, fortunately, no scarcity of the valuable commodity, salt. At the annual meeting of the Chamber of Commerce of Stockton-on-Tees the president stated that the salt field of Teeside covered an area of 11 square miles, and that the vein was 70 feet thick on an average. Each acre, therefore, contained 200,000 tons of salt, and the district could supply the whole world for 800 years.

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A NEW process of salt manufacture has been discovered by Dr. Sigismund Pick, of Szezakowa, Austria, by which the surface of evaporation is reduced and the amount of fuel consumed is decreased. With this purpose Dr. Pick has contrived a system of chambers in which steam is forced, and after having performed its functions in one chamber is transferred to another. The advantages of the new system are obvious. In the first place there is a great saving in fuel, the consumption of coal being less than 4 cwt. per ton of salt. Other important advantages are the small amount of wear and tear, saving in labour, absence of smoke and deleterious vapours, and the great economy in space occupied. A 50 ton per day plant only occupies an area equal to that covered by a salt pan producing 40 tons per week.

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THE discovery is reported of a supposed fossil of unusually large dimensions at Raupo Bay, near Little Akaroa, on Banks Peninsula, New Zealand. The remains were found some five years ago, and some considerable time and labour have since been spent in unearthing portions of the supposed skeleton. It is said to extend some 15 chains, or 980 feet in length, and is about 100 feet above the sea level. The clay has been dug away in seven or eight places to show the spinal column. The breadth of the vertebræ is about 3 feet, increasing more or less in size towards the skull. The side of what is supposed to be the skull has been uncovered, and an eyehole is apparent. The side is oblong, and it is said to be like that which the iguanodon is said to have possessed. Some of the detached portions of the remains are said to be unmistakable bone, and others cannot be distinguished from "petrified clay." Three pieces form what is considered to be the fin or paddle of the reptile.

THE *Building News* of April 18th gives a number of portraits of contemporary British architects, which are well executed. Perhaps the most successful of the series is that of Mr. T. Mellard Reade, C.E., F.R.I.B.A., president of the Liverpool Architectural Society.

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SPECIMENS of obsidian, or natural glass of the Yellowstone, have recently been analysed by M. Stanislaus Meunier, who finds it to consist of a double silicate of alumina and potash, which only differs from felspathic minerals by the great quantity of volatile matter it contains. This is chiefly vapour of water and chlorhydric acid, and is liberated when the glass is heated to redness.

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A SERIOUS landslip has occurred at Walton-on-Naze. Early in the morning the tenants of Burnthouse Farm, situate on the high cliff between Walton and Frinton, felt a severe shock and heard a rustling noise outside. Looking out of their bedroom windows they found that their front garden had slid down a ravine, and that one end of the house was overhanging the abyss. The Walton improvement and sea defences bill was, on the previous day, by a Parliamentary Committee, referred back for amendment.

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MR. C. J. WOODWARD, B.Sc., Principal Chemistry Department, Birmingham and Midland Institute, has published a new manual on A. B. C. Five-Figure Logarithms, with differences, on a new and simple plan, which will be found exceedingly useful in physical and chemical laboratories. The exercises given are simple, and the method of using the tables is easily grasped even by those who are unaccustomed to logarithms. Mr. Woodward has also compiled a series of "Questions in Natural Philosophy and Chemistry," and in "Mechanics and Experimental Science," given at the University of London Matriculation Examinations, from 1864 to 1880 inclusive. Both works are published by Messrs. Simpkin, Marshall and Co., London.

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DURING one of his expeditions, Professor Nordenskjold, before reaching Parry's Island, to the north-west of Spitzbergen, found the snow strewn with a multitude of minute black particles, spread over the surface or situated at the bottom of little pits, a great number of which were to be seen on the outer layer of snow. Many of such particles were also lodged in the lower strata. The dust, which became grey on drying, the professor found to contain a large proportion of metallic particles attracted by the magnet, and capable of decomposing sulphate of copper. An observation made a little later upon other icebergs proved the presence of similar dust in a layer of granular crystalline snow situated beneath a stratum of light fresh snow, and another of hardened snow. Upon analysis Professor Nordenskjöld found this matter to be composed in varying proportions of metallic iron, phosphorus, cobalt, and fragments of Diatomaceæ.

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WRITING to a contemporary on the subject of the division in the House of Commons recently on Mr. Buchanan's motion in regard to public rights of way in Scotland, a correspondent points out that Ministers evidently "do not take trouble to discover what the feeling is about the closing of so many paths by Scotch proprietors who make deer forests, and are preserving game upon hillsides where at one time everybody was free to stray and stroll as he pleased. An artist who sits down to take a sketch is immediately warned off by a forester. The tourist who leaves the high road is at once spied and admonished. The villager who goes to take a walk on Sunday afternoon is threatened with an action for trespass. Roads are closed which have existed for centuries, and they can only be opened again by very costly proceedings at law. This state of things is making the Scotch peasantry land nationalizers."

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INDUSTRIAL AND LOAN EXHIBITION AT BOURNEMOUTH.—Among the exhibits worthy of special notice in the science department, under the direction of the Rev. Dr. West and Mr. C. Carus-Wilson, of the Bournemouth Industrials and Loan Exhibition, opened on the 7th ultimo, may be mentioned the collection of British and Foreign oysters, lent by the Poole Oyster Fishing Co., also the collection of birds' eggs, which gained for Mr. Gray a special prize. Mr. Davies exhibited a collection of recent and fossil local shells, for the perfection of which he was awarded the first prize. The stages in the development of photographs, arranged and lent by Mr. Jones, formed a most interesting exhibit. In the geological section the fine specimens of fluor lent by Dr. West were much admired, and his collection of Eocene fossils from the London, Hampshire, and Paris Basins found a most valuable addition to the list of exhibits. Mr. C. Carus-Wilson lent a case of remarkably well-preserved fossils of various geological ages, including a gigantic shark's tooth *(Carcharodon)* from Rio; also a fine specimen of garnets in quartz, and samples of musical sands. Leaves from the Bournemouth beds were well represented by Mr. Bennett's collection. In the entomological section Mr. McRae's collection of British lepidoptera attracted much attention; the *rhopalocera* and *macro-heterocera* are almost entirely represented, a large number having been bred by Mr. McRae from larva obtained in or near Bournemouth. A special prize was awarded to W. Harding for a large astronomical telescope, constructed by himself; it possesses a speculum 9·3 inches diameter, three powers on revolving eye tubes, 2 in. achromatic finder, slow motion in R.A., and is capable of dividing stars 0·6 asunder. Some interesting "Voice Pictures" were shown by Mrs. Watts Hughes.

Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between March 16th and April 15th inclusive, and are deduced from observations taken under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board:—

(*a*) Barometer	Highest (April 1st)	30·35	Inches.
,, ,,	Lowest (March 16th)	29·03	,,
,, ,,	Mean	29·751	,,
,, ,,	,, for 23 years March	29·920	,,
,, ,,	,, ,, April	29·879	,,
Temperature	Highest (March 28th)	60·0	Deg. F.
,,	Lowest (March 17th)	32·9	,,
,,	Mean	44·8	,,
,,	,, for 23 years March	41·7	,,
,,	,, ,, April	47·1	,,
,,	,, of Evaporation	41·5	,,
,,	,, ,, for 23 years March	39·1	,,
,,	,, ,, April	43·4	,,
(*b*) Rainfall	Amount	1·916	Inches.
,,	,, Mean for 23 years March	1·727	,,
,,	,, ,, April	1·650	,,
,,	Number of Days on which Rain fell	18	
,,	Greatest fall in 24 Hours (March 16th)	0·391	Inches.
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	5·9	
,,	,, ,, for 23 years March	6·6	
,,	,, ,, ,, April	6·5	
(*c*) Wind	Velocity, Greatest (April 7th)	46	Miles.
,,	,, Least (April 11th)	1	,,
,,	,, Mean Hourly	16·3	,,
,,	Greatest Pressure on Square Foot (April 7, 9-30 a.m.)	20·0	Pounds.
,,	Direction at time of Greatest Pressure	W	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
43	88	162	62	78	167	119	25	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed one foot above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

THE WEATHER.—*March 15 to April 14, 1890.*

From the 15th to the 21st March the barometer was below the average, with four wet days. Temperature varied from 51° on the 16th to 39·5° on the 20th. The means for the week were:—Barometer 29·432 in.; temperature 42·41°; humidity 81·4%; total rainfall 0·508 in.; sunshine 13 hours 5 minutes; prevailing winds S.E. and W. During the last ten days the barometer was unsteady until the 27th, making a range of 0·7 in., with more or less rain each day; from the 27th it began to rise gradually, and reached 30·3 in. on the 31st. The temperature, except on the 22nd and 24th, was above the average, reaching 52·38° on the 28th. Means:—Barometer 29·762 in.; temperature 44·78°; humidity 84%; total rainfall 1·547 in.; sunshine 28 hours 50 minutes; winds variable.

With the exception of the first four days of the month of March the weather was mild, with rainfall and sunshine above the average, and altogether favourable to vegetable growth. The extreme range of temperature, 35·1°, was very great; the mean, corrected for daily range, 41·86°, was 3·5° above the average; while the means of thermometers in the soil and water were about 2° above the average; and the mean of terrestrial radiation, or loss of heat from the earth during the nights, was 3·6° less than last year. The month's rainfall, 3·727 in., brings up the accumulated amount of the year to 9·715 in., or 2·5 in. more than in 1888 or 1889, and 4·1 in. more than in the year 1887; while the accumulations of "growing" temperature for the same period show a most decided increase this year.

During the first five days in April the barometer was above the average, with fine bright weather but wide daily range of temperature, the cloudless sky bringing down the minimum to below freezing point on four nights, with hoar-frost on five nights. The last two days of the week the barometer fell to 29·4 in., accompanied by rain, which produced a more equable temperature. The sun shone every day, to a total much above the average. The means for the week were:—Barometer 30·047 in.; temperature 42·43°; humidity 79%; total rainfall 0·549 in.; sunshine 30 hours 20 minutes; wind, light Westerly breezes. From the 8th to the 14th the barometer made several oscillations, but low range, with slight rainfall on five days; temperature was low, on the 12th being below 37°; slight hail and snow fell on the 8th, and hoar-frost on the 11th and 12th. The means were:—Barometer 29·778 in.; temperature 39·56°; humidity 71%; total rainfall 0·206 in.; sunshine 20 hours 35 minutes; wind N. and E.

W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, April 16, 1890.

Sheffield.

METEOROLOGICAL SUMMARY.

March, 1890.	TEMPERATURE.					Means for Mar.*		RAINFALL.					
	Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Daily Max.	Daily Min.	Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date	Mean for Mar.* Ins.
Sheffield ...	61°	28th	23°	4th	43°	—	—	2·48	14	0·44	23rd	—
Spurn Head.	62°	28th	25°	2nd	43°	—	—	1·57	12	0·84	19th	—
York	61°	28th	25°	3rd	44°	49°	34°	1·37	17	0·27	24th	1·63
Liverpool ...	60°	28th	26°	3rd	44°	47°	37°	1·61	17	0·39	16th	1·69
Holyhead ...	56°	31st	30°	4th	44°	48°	39°	2·34	19	0·43	27th	2·21
Yarmouth ...	59°	28th	22°	4th	42°	46°	36°	2·18	19	0·72	19th	1·77
Oxford	63°	28th	17°	4th	43°	49°	35°	0·84	16	0·14	24th	1·52
London	66°	28th	15°	4th	44°	51°	36°	1·98	15	0·44	19th	1·43

* The means are for 15 year

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The intense cold at the beginning of March was almost unprecedented, while the high temperature of the 28th has rarely been reached at the same period during the last 50 years.

PRESSURE.

March 16 to April 15, 1890.

On March 16th the centre of a depression with readings down to 20·9 in. was over the Irish Sea, and pressure was consequently low over England; but on the 17th the depression had filled up and the barometer was rising. Pressure was low and rather irregular on the 18th, but on the 19th it had risen decidedly, the readings ranging from 29·4 to 29·7 in. On the 20th a depression to the East of England caused a slight fall, and the fall continued on the 21st, with a slight rise on the 22nd, which was continued on the 23rd, and on the 24th there was a further fall, with readings ranging from 29 2 to 29·5 in. The centre of a depression, with readings down to 29·1 in., was over England on the 25th, but this had passed away on the 26th and pressure was recovering, and it continued to do so on the 27th, when readings were 29·4 in. in the N. and 30·0 in. in the S. The barometer was slowly rising on the 28th but gave way again on the 29th, with a decided rise on the 30th, and on the 31st it was high, the readings being about 30·3 in. in nearly all places. The barometer remained above 30·0 in. until April 6th, when it was falling, and the readings were 29·6 in. in the N. and 29·9 in. in the S., the fall continuing on the next day, followed by a recovery on the 8th, and on the 9th the barometer was between 29·8 in. and 30·0 in., and remained the same on the 10th and 11th, with a fall to 29·8 in. all over England on the 12th. On the 13th it fell quickly to 29·6 in., and was low on the 14th but rising, very little change having occurred on the 15th, when the readings were 29·4 in. in the S. and 29·7 in. in the N.

THE WEATHER.

During the week ending March 22nd the weather was very changeable and unsettled, with frequent falls of rain in all parts of the kingdom, and occasional sleet or snow at some places. Temperature was about the normal, being warmest at the beginning of the week, when it reached 60°, but afterwards it fell, and slight frosts occurred in many parts of England. Rain fell on six days at London, five at York, Oxford, and Yarmouth, four at Sheffield, Spurn, and Liverpool, and three at Holyhead. From the 23rd to the 29th the weather continued unsettled and showery, but the rainfall was not so heavy as in the previous week. Temperature was moderate most of the time, but on the 28th it was unusually high for the time of the year, the maximum being above 60° at most places, and reaching 66° in London, this temperature having been exceeded on only two previous occasions in March within the last 50 years. There was rain on six days at Liverpool and Holyhead, five at York, four at Sheffield, Oxford, and Yarmouth, and three at Spurn and London. The following week (March 30th to April 5th) there was a decided improvement in the weather, which was fine and bright throughout, with mild day temperatures, but cold and often frosty at night. There was rain on the last day (April 5th) at York, Liverpool, and Holyhead, but no rain at any of the other places named in the table above. In the week ending April 12th the weather again became unsettled and showery, the showers oftentimes consisting of snow or sleet, and the temperature was generally low, sharp frosts occurring at night. Rain fell on seven days at Spurn and Yarmouth, five at Liverpool, London, and Oxford, and four at Sheffield, York, and Holyhead. During the week ending April 19th the weather varied considerably in different parts of the kingdom, being fair in the North but cloudy or dull elsewhere, with considerable falls of rain in the South and smaller amounts in other districts. Thunder and lightning occurred in places. In the first half of the week temperature was moderately high but afterwards it fell, and was decidedly low for the time of the year, the maximum readings being below 50°. Rain fell on five days at Oxford, four at London, three at Sheffield, Liverpool, and Holyhead, and one at Spurn, York, and Yarmouth.

SUN SPOTS.

No sun spots were visible during the month ending April 15th.

E. HOWARTH, F.R.A.S.

Museum and Observatory, Sheffield, April 21, 1890.

Societies and their Work.

YORKSHIRE societies, as is their wont, have been well to the fore during the past month, and several meetings held by local societies in the county have been very attractive. The members of the LEEDS GEOLOGICAL ASSOCIATION, under the able guidance of Mr. B. Holgate, F.G.S., visited Castleford to inspect the upright fossil tree (*Sigillaria*) lately found in Messrs. Hartley's quarry at Whilwood Mere; it measures 6 feet in height, 20 inches in diameter at the bottom, and 10 inches in diameter at the top. The sections in the coal measures at this spot were examined with much interest. A party of geologists from HUDDERSFIELD proceeded to the East Coast, making Scarborough a centre for the study of the Lias and Oolite. Sections were examined along the coast from Filey to Whitby.

THE Rev. E. Jones, of Embray, has been directing the attention of the LEEDS NATURALISTS' CLUB to the valuable relics found in Yorkshire caves, especially to the latest "finds" at Elbolton. The subject of "Bacteria in Relation to their Condition in Life" has also been ventilated by Professor E. H. Jacob at a meeting of this club.

AT WAKEFIELD the local NATURALISTS' SOCIETY have had a paper read before their body by Mr. T. Garnett, on "Abnormality in Plants," in which the author pointed out the parts of a number of flowers which had become modified, thereby rendering the flower more interesting and beautiful.

IT is satisfactory to record that the operations of the HULL SCIENTIFIC CLUB during the past winter session, especially in the Conchological section, have shown a marked improvement over previous achievements.

FROM the report of the CRAVEN NATURALISTS' ASSOCIATION, presented at their annual meeting, we are glad to note that this useful association is making good progress. The Rev. E. Jones has been elected president for the ensuing year.

THE usual Easter excursion of the LIVERPOOL GEOLOGICAL ASSOCIATION was, this year, held at Colwyn Bay. The work planned out for the occasion by the excursion superintendent included a study of the fine sections of drift deposits along the coast. Mr. J. Wilding read a useful paper, on 31st March, on "The Paving Materials of Liverpool."

AT the April meeting of the LIVERPOOL SCIENCE STUDENTS' ASSOCIATION Mr. I. E. George gave an interesting account of "Some Natural Monuments and their History," illustrated by a fine series of photographs of sea-stacks and inland pillar-rocks, tors, and isolated rocky remnants of ancient denudation.

A MISCELLANEOUS evening was provided for the members of the LIVERPOOL GEOLOGICAL SOCIETY at their last meeting. Mr. J. J. Fitzpatrick gave an account of the recent discovery of a Bone-cave at Deepdale, near Buxton, and Messrs. E. Dickson and P. Holland presented a note on the examination of some Anglesey rocks. Mr. H. C. Beasley discussed the question of "What Becomes of the Water Ejected from Volcanoes?" suggesting that much of it was absorbed by the fine dust thrown out from the volcano during eruption. Mr. Mellard Reade contributed a note on some mammalian bones found in the blue clay under the Peat and Forest bed at the mouth of the river Alt.

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The Liverpool Amateur Photographers held an "optical lantern evening" on the 14th April, when about 150 slides of the completed survey of Wirral, taken by various members, were shown, the description being given by Mr. J. Hargreaves. A new set of views, taken by the New Boston (U.S.A) Society, entitled "The White Mountains," was also exhibited.

At the April meeting of the Manchester Amateur Photographic Society several prints taken for the new survey of Manchester and Salford were laid on the table, and it was announced that special parties had been organised to photograph Ancoats and Salford. Mr. Howie gave an interesting account of a tour in Norway.

A revival of stereoscopic photography, so long gone out of fashion, has been attempted by Mr. J. P. Gibson, of the Newcastle Photographic Association, before which body a paper by that gentleman was recently read.

Castle Mill and the Bollin Valley were selected for the opening excursion of the season by the Manchester Scientific Students' Association. There will follow visits to the Ship Canal works, Styal, Sherwood Forest for three days in Whitsun week, Birkdale, and Buxton. There will also be Wednesday evening rambles to Chadkirk Valley, Clibran's floral nursery at Altrincham, and Woodheys Hall, Ashton-on-Mersey.

The programme of the Manchester Field Naturalists' Society for the first half of the summer season announces excursions to Didsbury, Wilmslow, Southport, Sale, the Upper Goyt Valley, Marple, Ingleton, Dunham Massey, and Ashford-in-the-Water and Monsall Dale. The Whitsuntide three days' excursion will be to the Dukeries and Sherwood Forest, with Mansfield as the headquarters. Mr. Leo Grindon's Tuesday evening lectures at the Botanical Gardens, Old Trafford, will be resumed at the end of May.

Mr. G. Espaile, C.E., described the chief Roman camps of Lancashire and Cheshire before the Society of Antiquaries in Manchester.

One of the most successful gatherings of the Manchester Field Naturalists was the spring *soirée*, at which Alderman Bailey discoursed on his favourite topic, the Ship Canal.

The Geological Society of Manchester had a long programme before them on the 3rd April. Mr. J. Crankshaw read a paper on "Irrigation and Water Storage in the United States;" Mr. T. Bell, H. M. Inspector of Mines, gave an account of the Lackenby Foreshore Salt Boring; and Mr. M. Stirrup, F.G.S., communicated a translation of Professor Geinitz's work on the Trias [Dyas] around Manchester, to which Mr. C. Roeder added a brief note.

The energetic Microscopical Society of Manchester met on 10th April, when Mr. E P. Quinn resumed his elucidation of the "Embryology of the Chick."

Reports of Societies.

General Science.

Liverpool Polytechnic Society—At the March meeting of this society, Mr. Charles Kohn, B.Sc., Ph.D., sketched in outline the development of the coal-tar industry, tracing its rise in this country from the introduction by Bethell of his method for creosoting timber in 1838. He then referred to the sources of coal-tar, other than the destructive distillation of coal for the manufacture of coal gas; these include the recovery of tar from coke ovens, water and producer gas, and from the gases of the blast furnaces. The tar from the closed coke ovens of the Otto and Simon Carve's types have alone proved themselves the true analogues of the coal-tar from the gasworks, the others yielding low-temperature products, which were of little value to the tar distiller. A short account of the method of distillation of coal-tar followed, illustrated by lantern slides and diagrams. The several products of distillation were then taken in turn, and the most recent applications of the derived substances treated of. These included a number of colours, such as the benzidine and primuline colours, characterised by their dyeing cotton without a mordant; the use of eosin, &c., in orthochromatic photography; eikonogen, the new photographic developer, derived from naphthalene; cresotinic acid in its use for unliming hides in tanning operations, &c. The concluding portion of the lecture dealt with the pyridine and quinoline bases contained in the tar, and the method of their extraction. Their relation to the natural alkaloids was explained, and the future that these bodies held out in regard to their serving as the starting point for the preparation of important artificial drugs was dwelt upon. Kalrin, antipyrine, and other artificial drugs are closely related to these bases, and Dr. Kohn exhibited some allied bodies he had prepared with a view of tracing out a relationship between the chemical constitution and the physiological action of these bodies.

Liverpool Science Students' Association.—The annual meeting of this society took place at the Royal Institution, Mr. E. D. Fish presiding. Several donations to the library were announced. The report of the committee stated that field meetings had been held during the summer months. Visits also had been paid to various works and manufactories, and the committee expressed their thanks for the kind permission and attention given in each case. During the winter session the meetings at the Royal Institution had been well attended, and the papers read had been of a useful and interesting character. The statement of accounts as presented by the treasurer showed a small balance in hand. Mr. E. D. Fish was elected president for the ensuing year, and Messrs. J. J. Fitzpatrick and I. E. George vice-presidents. Mr. R. H. Day and Mr. J. Butler Davies were re-elected treasurer and hon. secretary respectively.

Liverpool Literary and Philosophical Society.—The 13th ordinary meeting of the season was held on April 14th, in the Royal Institution, the Rev. H. H. Higgins, president, in the chair. After having disposed of the customary preliminary business, the president reminded the meeting that the Association of Curators of Museums would visit Liverpool next June, and he trusted that the society would give such a reception to these gentlemen from all parts of the country as befitted the occasion, and as would do honour to themselves—such a reception, for instance, as they had extended to the librarians. He then made some general references to the contributions for exhibition that evening, the objects of which were to furnish examples of illustrating the history and development of writing, printing, and engraving. There was a very large and highly-interesting collection of rare and costly documents, manuscript volumes, printed books, etchings, engravings, lithographs, and photogravures, as well as instruments used in writing, and blocks and plates from which pictures were struck. Among the contributors were the president, who had selections from the Mayer Museum, and Mr. F. W. Holder, who showed specimens of writing on the talipot palm. Books upon alchemy and early chemistry were sent in by Dr. Campbell Brown and Mr. Alexander Watt. The most unique collection was that of Mr. John Newton, among whose books was a beautiful copy of the famous "Nuremberg Chronicle" (1493), a history of the world from the creation to that date, illustrated profusely, and altogether a very handsome specimen of the printing of that period. Dr. Nevins produced a rare copy of the Gospels in the Northumbrian dialect of the eighth century; and Mr. O. W. Jeffs contributed a number of examples to illustrate the process of the photo-printing of pictures,

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or the application of photography to lithography and engraving. The specimens included the photo-zinco process, photogravure, and collotype, and the actual blocks were shown besides the pictures. The chief part of this collection had been kindly lent for the occasion by Messrs. Waterlow and Sons, London. Examples of blocks produced by the "Meisenbach" process were also shown.

Botany.

EALING GARDENERS' SOCIETY.—The Rev. Percy Myles, B.A., F.L.S. (editor of *Nature Notes*), lectured on "The Names of Garden Plants." The lecturer stated that in the case of many plants the popular names were entirely deceptive and misleading as to their true botanical position and relationship; *e.g.*, what was called the laurel (*Cerasus Laurocerasus*) was in truth related to the cherry, and its leaves (strongly impregnated with hydrocyanic acid) were often used for flavouring, owing to its name creating a confusion with the true laurel, or sweet bay tree (*Laurus nobilis*). So the mountain ash was truly a pear, the horse chesnut was akin to the maple not to the chesnut, the lesser calandine was a buttercup, the garden nasturtium (nose-twister) was a tropæolum, the garden syringa a philadelphus, while the real syringa was the lilac. The so-called corchorus was a kerria belonging to the rose family, and widely different to the true corchorus. Ground ivy, buck-bean, and buck-wheat had nothing to do with the plants whose names they had assumed, while the knot-grass was certainly *not* grass. Again: certain words suggested a derivation very different to the real one, and as the original meaning had been altogether obscured and overlaid by popular etymology mistakes were not unnatural. For example: the mandrake had nothing to do with men or drakes, but was a corrupted form of the Greek *mandragora*, mentioned by Shakespeare in "Othello." Mistletoe was toeless, and came from *mistl*, slime, and *tau*, a twig; the periwinkle had no connection whatever with the popular mollusc, but was an erroneous pronunciation of the Latin *pervinca*, a twiner; pennyroyal bore the name, not of pence, but of fleas, against which it was esteemed a royal remedy, as shown by its old name *puleium*. Wormwood came, not from worm and wood, but from two Anglo-Saxon words meaning preserver of the mind. Walnuts were not the nuts of the wall, but the foreign (*wealh*) nuts. Rosemary was not compounded of two pretty names of girls, but came from the Latin *ros marinus*, and meant sea-dew; so the primrose contains no reference either to prim or rose, but is an altered diminutive of the Latin *primula*. Shamrock is not two English words, but one Irish word, meaning the little trefoil. Horehound has no reference to dogs, but to its strong odour (*hune*). Tulip was really the same word as turban, and came from a Turkish source. The gooseberry was more properly the cross-berry. The word which united most popular blunders was the Jerusalem artichoke. Jerusalem should be *girasole* (turning to the sun), alluding to a generic name of the plant sunflower, or *helianthus*, and artichoke did not refer to the "choking" of the eater, but was derived from the Arabic *alharshaf*. A very interesting class of plant-names was those derived from names of persons. The derivation was often much disguised, as in samphire, which was connected with St. Peter, through the French *St. Pierre*. The "Jenneting" apple was not a "June-eating" one, as often said, but was a corruption of *Jeanneton*, or *pomme de St. Jean* (St. John's apple); filbert was under the protection of another saint, Philibert; quassia commemorates the merits of the negro Quashy. Camellia bore the name of the missionary Kamel; dahlia, of the Swedish botanist Dahl; and fuchsia, the German *Fuchs*, or Fox. Fruits especially seemed to have been derived from names of places. The currant was the Corinthian fruit, the peach the Persian, while the damson took its name from Damascus. The cherry, chestnut, quince, and a host of others had like local etymology. When they came to the scientific names of plants they found that the Greek and Latin formed the immense majority, and this made the ascertaining of the derivations considerably easier, as the classical languages had now been studied with so much care that there was little difficulty in ascertaining the etymology of any particular word. A specially-common blunder was that which, in accordance with old-fashioned notions, derived Latin or Greek words from Hebrew or Celtic roots. They might be quite sure that when this was done, in 99 cases out of 100 the derivation was incorrect, unscientific, and contrary to all sound laws of philology. The scientific names of plants might be divided into four classes:—(1). Those derived from the old classical writers. (2). The modern compounds of classical words, most of which were derived from a comparatively small number of roots, which, if once learned, gave a key to the whole subject. (3). Names of great botanists and gardeners. (4). Names taken from the so-called barbarous or aboriginal languages, Japanese, Malay, native American, &c.

Engineering.

LIVERPOOL ENGINEERING SOCIETY.—The twelfth ordinary meeting of the session was held on March 26th, Mr. H. H. West, M. Inst. C.E., president, in the chair. A paper was read by Mr. Thomas L. Miller, Assoc. M. Inst. C.E., on the "Efficiency of Gas Engines," in which the author referred to the practice of stating the efficiency of gas engines in terms of the gas consumption per horse power per hour, without any reference to the thermal value of the gas used, and showed, from a comparison of the calorific value of the gas in different districts, how unfair such a practice was when the efficiency of engines tested in different localities was so compared. An explanation of the different senses in which the term "efficiency" was used in the paper was then given, after which the author proceeded to explain the system of classification of gas engines adopted by Mr. D. Clerk, the theoretical efficiency of the various types being given. The causes of loss in the gas engine were then referred to in detail, and the means by which such losses might be reduced explained. The experiments of Messrs. Clerk and G. C. Douglas in the explosion of gaseous mixtures were then touched upon, and the various theories advanced to account for the suppression of heat at the moment of ignition were dealt with. A discussion of the more important tests on gas engines then followed, the absolute amount of heat supplied to the engines per horse power, together with their efficiency, being given. The Hargreaves motor was then referred to and explained, and a comparison was made between the results of tests with this engine and those of the most economical gas engines mentioned. The author then concluded the paper with a comparison of the efficiency of the gas engine with that of the steam engine, in the course of which he pointed out that while the gas engine had the advantage from a thermo-dynamic point of view, the high price of its fuel soon placed it at a disadvantage, as, with coal gas at 3/- per 1000 cubic feet and coal at 15/- per ton, the gas engine with a consumption of 20 cubic feet of gas per indicated horse power per hour was just equal in the cost of fuel to that of a steam engine indicating one horse power per hour for a consumption of nine lbs. of coal.

Entomology.

LANCASHIRE AND CHESHIRE ENTOMOLOGICAL SOCIETY.—The monthly meeting of this society was held on Monday, April 14th, in the Free Library, the president (Mr. S. J. Capper, F.L.S.) in the chair. The Rev. Samuel Gasking read a paper on spiders, in which he gave a brief account of the structure and habits of each genera of the British spiders, and referred to the popular errors that had and still existed as to their medicinal properties, the most common of which was to enclose a spider in a bag and suspend it round the neck as a cure for fever and ague. The president made some remarks on the recent discussions on the white-bordered *Vanessa Antiopa*, and read a letter he had received from Mr. Wurzburger, enclosing two specimens of

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V. Antiopa with the white borders, which he had captured on Good Friday in Germany. During the *conversazione* (through the kindness of Mr. T. J. Moore) were exhibited the local spiders collected by the Rev. H. H. Higgins; there were also different parts of spiders shown under microscopes by Messrs. Walker, Harker, &c. The president exhibited some fine varieties of *Smerinthus populi* and *tiliæ*, and Mr. Sydney Webb, of Dover, nine extraordinary varieties of the little varying *Argc galathea*.

Geology.

GEOLOGICAL SOCIETY OF LONDON.—On March 12th, Mr. W. Whitaker, B.A., read a paper on "A Deep Channel of Drift in the Valley of the Cam, Essex." The author described several deep borings and well-sections through the drift in the higher part of the valley of the Cam, which revealed an unexpected thickness of glacial deposits. Near Wenden two wells show a thickness of 210 and 296 feet of drift respectively, and at Littlebury a boring of 218 feet did not pierce the drift. It has been proved that the drift often comes up very abruptly against the chalk, and occupies, in fact, an old pre-glacial valley of erosion. Professor J. F. Blake, M.A., read a communication on the "Monian and Basal Cambrian Rocks of Shropshire," in which he divided the lower group of Longmynds into five parts:—(1) Dark Shales; (2) Banded Series; (3) Purple Slates; (4) Hard Greywackes; (5) Pale Slates and Grits, having a dip to the west and not thrown into folds. It is in these only that fossils have been found. The upper group represents the true Cambrian, and consists of three members. The author claims that the volcanic group on the east represents the interval between the Monian and Cambrian. Mr. R. Lydekker, B.A., described "A Crocodilean Jaw from the Oxford Clay of Peterborough," and "Two New Species of Labyrinthodonts," from the Lower Carboniferous of Gilmerton, near Edinburgh.

LIVERPOOL GEOLOGICAL SOCIETY: EASTER EXCURSION.—A small party of this society had a very pleasant six days' excursion, commencing on the 3rd of April, to Leicester and neighbourhood, under the guidance of one of the members, Mr. Linnæus Cumming, of Rugby. On reaching Atherstone they explored some of the principal quarries between Atherstone and Nuneaton. The Hartshill quartzite and associated beds are, though formerly considered to be Carboniferous, now known to be Lower Silurian, thanks to the labours of Professor Lapworth and others. Taking train from Nuneaton to Leicester the party were joined by Mr. John D. Paul, F.G.S., and Mr. Montagu Browne, F.G.S., F.Z.S. Under the guidance of the latter gentleman the Brick Pit at Wigston was thoroughly explored. Here is to be seen one of the finest sections in the country, showing the succession from the New Red Marl of the Trias through the Rhætic to the Lias. Mr. Browne, who has worked the various zones of the Rhætic, pointed out the *Avicula Contorta* bed and the passage beds between the Rhætics and the Lias. The third day was devoted to the Lias of Barrow-on-Soar, where Mr. Montagu Brown has discovered numerous fish remains, one of them being new to science. The members collected a variety of characteristic fossils. In the railway cutting Mr. Browne, by a little digging, proved to the satisfaction of the members the position of the *Avicula Contorta* bed of the Rhætics, and showed that the succession of zones at Barrow-on-Soar is the same as at Wigston. On the fourth day Mr. Paul led the party through Leicester to Bradgate Park, in Charnwood Forest, pointing out many topographical and archæological features on the route. The rocks of Charnwood Forest, at the south end of the anticlinal at Holgate Hill, were examined, and the bedding and cleavage of the strata noted, as well as the igneous intrusions amongst slates at the Stable Quarry, Bradgate Park. The slaty agglomerates east of the tower, called "Old John," were examined and specimens taken. Bradgate House, of which only some of the walls remain as evidence of the excellence of the brickwork of the fifteenth and sixteenth centuries, was well examined. Historically, the building is interesting as having been the scene of Roger Ascham's tuition of Lady Jane Grey. The fifth day the party had to make shift without local guidance, and devoted the time to an examination of the celebrated Mount Sorrel granite (Syenite) quarries. Some very interesting facts were noted here, and good examples of epidote were taken, showing how it had arisen from the decomposition of the constituents of the Syenite. A pleasant walk from Mount Sorrel to Swithland slate quarries and a drive home completed the day. The sixth and last day was spent at Rugby, where Mr. Cumming showed the party over Rugby School and, afterwards, the Rugby Cement Works, where the interesting process of the manufacture of Portland Cement was observed. While in Leicester, the Museum, of which Mr. Browne is curator, was specially lighted up in the evening, and the contents explained to the party. The excellent and artistic arrangement of the birds and the naturalistic modelling of the backgrounds and surroundings, all the work of Mr. Browne, excited much admiration.

Meteorology.

ROYAL METEOROLOGICAL SOCIETY.—At the meeting of this society, held on the 19th March, at the Institution of Civil Engineers, Westminster, Mr. H. F. Blandford, F.R.S., vice-president, in the chair, papers were read as under:—(1) "A Brief Notice Respecting Photography in Relation to Meteorological Work," by Mr. G. M. Whipple, B.Sc., F.R.A.S. The first person to use photography for obtaining meteorological records was Mr. T. B. Jordan, of Falmouth, in 1838. Some years later Sir F. Ronalds and Mr. C. Brooke devised more complete and elaborate apparatus, the arrangement of the former being now in use at the observatories of the Meteorological Office, and that of the latter at the Royal Observatory, Greenwich. Reference was also made to Mr. J. B. Jordan's form of sunshine recorder, and to Captain Abney's photo-nephograph. The various photographic processes which have been employed in connection with these instruments were fully described. (2) "Application of Photography to Meteorological Phenomena," by Mr. W. Marriott, F.R.Met.Soc. The author showed how photography could be most usefully employed for the advancement of meteorological knowledge. Much valuable information had been recently obtained from photographs of lightning and clouds. An interesting collection of such photographs was shown on the screen, together with others illustrating floods, whirlwinds, tornadoes, hail-storms, frost, snow, &c. After the reading of these papers the meeting was adjourned to allow the Fellows to inspect the exhibition of instruments, &c., illustrating the application of photography to meteorology. Not only were specimens or drawings of nearly every photographic meteorological instrument and records from the same shown, but also a most valuable and interesting collection of photographs of clouds and other meteorological phenomena. The photographs from clouds, taken by Mons. P. Garnier, of Boulogne-sur-Seine, were exceptionally fine. The tornado cloud is perhaps the rarest kind of all. There were several photographs of it from the Western States of America. In some it appears to be a dark, whirling mist or smoke between the parent mass above and the ground, and might be mistaken for a shower of rain falling from a nimbus cloud in the distance. In others it is a distinct "spiral-shaped funnel," or cornucopia-like appendage, which trails along at a considerable height above the ground, with its pointed end downwards. This form resembles a water-spout as seen from a vessel. Pictures of the devastation caused by these prairie tornadoes were also on view, showing houses dismantled or levelled with the ground, blocks of wood which had been shot through walls, and a fine horse, which was blown 1,000 feet, with the manger to which it was tied. Photographs of lightning exhibited a fair variety of types, some showing a peculiar tanglement of the flash, others double and triple striped or

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"ribbon" flashes, and others remarkable folded sheets of light, resembling white gauze. There was also a very fine representation of the "dark flashes." They appeared as dark rifts in the sky or background of the photograph, and seemed to branch out from the central streak of light. The photographs of winter scenes from Niagara to the summit of Ben Nevis were also very interesting. Some of them showed very well how rime or hoar frost "grows" out towards the direction from which the mist or fog which gives them birth is driving. A number of new meteorological instruments were also exhibited, as well as an ingenious working model, devised by Mr. A. W. Clayden, for showing the connection between the monsoons and the currents of the Arabian Sea and the Bay of Bengal. It consists of a model of that great marine basin between Africa and the Far East, with little pipes projecting over the Continents. These pipes communicate with a bellows placed under the table, and are the sources of the winds. The ocean consists of water lying on a blue bed, and dusted with lycopodium powder to show the movement of the currents. To imitate the south-west or summer monsoons the wind from the bellows is caused to escape from a group of pipes over the east coast of Africa, and easterly currents are thereby established in the Arabian Gulf and Bay of Bengal. The north-east or winter monsoons are imitated by pipes at the north-east of Asia, and give rise to westerly currents. The great equatorial current only shifts its position slightly because of these monsoons.

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Microscopy and Natural History.

Birmingham Microscopists' and Naturalists' Union.—At the meeting on March 31st Mr. J. Madison exhibited specimens of *Dreissena polymorpha* from the Oxford canal, near Brinklow, peculiar from having a white band along one valve; Mr. J. Collins, *Marchantia polymorpha*, showing sexual fructification; Mr. G. H. Corbett, specimens of *Ptirinea retroflexa*, and *Theca antiqua* from the Dudley district; Mr. Linton, cases of land, fresh-water, and marine shells, British and foreign. Under the microscope, Mr. H. Hawkes showed *Jungermania pusilus*, and Mr. Camm a series of fungi, including *Badhamia utricularis* and *B. macrocarpa*.——On April 14th Mr. J. W. Neville showed a number of leaf impressions from the Bournemouth beds. Mr. H. Hawkes exhibited a collection of marine algæ from Swanage. Mr. S. White, land, fresh-water, and marine shells from Swanage; Mr. C. P. Neville, a collection of foreign ferns; Mr. J. Madison, fossils from the Barton beds, including some Pholas taken from lignite, and a series of *Neritina fluviatilis*, including the yellow and black varieties. Mr. G. H. Corbett called attention to the confusion of the beds at Barton Cliff, caused by landslips.

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Hertfordshire Natural History Society.—A meeting of this society was held on April 16th, at St. Albans, chiefly devoted to photography. Mr. S. Monckton White read a paper on "The Art of Photography," after which a communication by Mr. John Hopkinson, F.L.S., F.G.S., &c. (in the unavoidable absence of the author), was read by Dr. Morison, on "Scientific Investigations in Hertfordshire in Connection with the British Association." The author pointed out that as an inland society they had to exclude all investigations relating to the sea-shore, and could not, for instance, assist the committee of the British Association at present working on tidal observations. The committees they could assist were:—In meteorology, the one on the temperature of rivers; in geology, those on underground waters, erratic boulders, and geological photography; in botany, that on the disappearance of native plants; and in archæology, that on pre-historic remains. The work of the committee appointed for the purpose of receiving particulars with regard to erratic boulders had already been brought before their society by Mr. Fordham, and he and other members had rendered assistance to that committee by giving accounts of the occurrence of such boulders in the north and centre of Hertfordshire. Several of their members were also carrying on investigations as to the circulation of underground waters in the chalk of the county, and they had already had two papers from Mr. Fordham on the height of the water for a considerable period of time in deep wells at the north. At a meeting of the British Association at Bath in 1888 the subject of geological photography was brought before the geological section by Mr. O. W. Jeffs, and also before the conference of delegates of provincial societies. It was pointed out that the chief object was to secure photographs of typical and especially of temporary sections. In the following year the subject was brought forward at the Newcastle meeting, and a committee was appointed to arrange for the collection, preservation, and systematic registration of photographs of geological interest, Mr. Jeffs being appointed secretary. A circular had since been received from Mr. Jeffs, asking for the society's co-operation in the work of the committee. To aid in this work he would ask the assistance of the professional as well as the amateur photographers in the county, and he hoped that something might be done in the course of the present summer. What was to be photographed? In the instructions of the British Association Committee a general idea was given, and doubtless many examples of sections and of views illustrative of the geology of their county might occur to the geological members. He would instance a few. A photograph of the chalk-pit at Boxmoor would show, by the absence of layers of flint and the presence of the chalk rock near the top, that it was mainly in the Middle Chalk. Photographs of the chalk-pits between Rickmansworth and Harefield would not only show them by the presence of layers of flint to be in the Upper Chalk, but would also give an instructive lesson in physical geology, for they would find that the chalk where covered by gravel was permeated by "pipes," and that where covered by clay there was not a pipe to be seen, the gravel allowing water charged with carbonic acid to percolate and dissolve the chalk, and the clay forming an impervious capping. Mr. Hopkinson also pointed out other geological features worthy of being photographed, and concluded:—Enough has perhaps been said to show that although there is but a small series of rocks present in Hertfordshire, there is sufficient of geological interest to give, with the aid of the photographer, an additional zest to our field meetings, to enrich the collection of our society with an interesting series of views, and to advance the science of geology, especially in its educational aspects, in which pictorial representation is such a powerful aid.——At a meeting of this society on April 22nd the following papers were read:—"Report on the Rainfall in Hertfordshire in 1889," by Mr. John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc.; "Hertfordshire Well Sections" (second paper), by Mr. William Whitaker, B.A., F.R.S., F.G.S.; "Notes on Birds Observed in Hertfordshire During the Year 1889," by Mr. George Rooper, F.Z.S.——A field meeting at Potter's Bar and Hatfield was held on April 19th, in conjunction with the Geologists' Association.

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The Liverpool Naturalists' Field Club.—The third evening meeting of the session was held at the Royal Institution on March 27th. Mr. Edmund Swift, Jun., read a paper entitled "Some Notes on Plants and Flowers, with Special Reference to the Common Daisy." In addition to dealing at considerable length with the structure and life-history of the daisy (*bellis perennis*), Mr. Swift described the action and construction of a series of sensitive and carnivorous plants. This portion of the lecture was made extremely interesting by the exhibition of living specimens of the following "sensitive plants," kindly lent by Mr. Richardson, of the Botanic Gardens:—*Mimoso sensitiva* (sensitive plant, Brazil), *passiflora princeps*, *drosera spathulata*, *dionæa muscipula* (fly-trap, Carolina), *paullinia meliofolia* (Brazil). Climbing plants and their various modes of growth were also alluded to. The lecture was illustrated throughout by a series of clever drawings.——The fourth meeting was held on April 10th, when Mr. J. Murray Moore, M.D., F.R.G.S., read a paper on "Plant Life and Growth." The subject

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was treated fully, and, with the aid of lantern illustrations, the construction and functions of the different parts of plants were clearly shown. Miss E. M. Wood read a list of plants found in flower during an afternoon's walk in the neighbourhood of Shotwick, some of these indicating an unusually early season.

LEEDS NATURALISTS' CLUB AND SCIENTIFIC ASSOCIATION.—*Studies in Insect Life.*—The meeting on March 17th was specially arranged to be of a more social character than usual. Those present were invited to examine a very extensive collection of objects bearing on the subject of "Insecta," explained by short addresses. The chair was occupied by Mr. H. Bendelack Hewetson, M.R.C.S., F.L.S. (one of the vice-presidents), who, in opening the meeting, gave an interesting account of some extraordinary sand beetles—living specimens of which were exhibited—obtained by him in the desert near Ismailia, Egypt. What is remarkable about these insects is that they were taken from the sandy desert, where no trace of life, either vegetable or otherwise, was to be seen. Their mouth parts and also their organs of sight are very rudimentary, and especially so when compared with coleopterous insects generally. Mr Hewetson also showed examples of Scarabei beetles, taken from Mentone. Mr. Edgar R. Waite, F.L.S., then described a number of interesting insects, illustrating his remarks by means of drawings thrown on the screen. Among others he described the drone fly (*Eristalis tenax*). This is a common British insect, and the larva is known as the "rat-tailed maggot." This larva is aquatic, and is very partial to water which oozes from manure-heaps. The oval body terminates in a long tail composed of two segements, one of which can be telescoped within the other. The larva feeds head downwards. Its tail places the body in communication with the air, and the sliding motion enables it to be lengthened or shortened as required by the varying depth of the water. Chameleon fly (*Stratiomys chamæleon*). The larva of this fly has a long tail, the extremety of which is provided with a circlet of barbed hairs. These are cabable of being folded together so as to enclose a small bubble of air, with which the creature descends, returning to the surface when the air is exhausted by respiration. The chigoe (*Pulex penetrans*), a near relative of our common flea, burrows into the feet of human beings, and if not ejected forms a hollow in which the young are produced. This little creature is popularly known as "the jigger." The cochineal insect (*Coccus cacti*) is one of the numerous tribe known to gardeners as "scales," or "mealy-bugs." This species supplies the cochineal of commerce. Mr John Stubbins, F.G.S., F.R.M.S., and other members also exhibited an extensive series of microscopic slides of insects.

SHEFFIELD NATURALISTS' CLUB.—The usual monthly meeting was held in the Montgomery Hall, on March 20th, the president, Mr. E. Howarth, F.R.A.S., in the chair. Referring to the series of excursions for 1890, which includes visits to Roche Abbey, Castleton, Thornewaste, and Eyam, the president said he hoped that members of the club possessing cameras would make use of them on those occasions, so that views of the places visited might be shown at a meeting to be held early in the autumn, when geological, antiquarian, or other features of interest could be discussed. A lecture was given by Mr. Thomas Dobb, entitled "Animal and Vegetable Life." The lecturer introduced his subject by alluding to the difficulty of distinguishing animals from plants as we approached the confines of each kingdom, since these differences, which are so obvious betwen the higher forms of animal and plant life, become quite inapplicable to the organisms on the borderline separating the two worlds. After describing the structural characters, means of obtaining food, and modes of reproduction of amœba, paramœcium, several species of foraminifera, and other members of the Protozoa, illustrations of which were exhibited by the aid of the lime-light, Mr. Dobb referred to the chemical composition of protoplasm, and pointed out that, although its analysis could be so accurately determined, yet it possessed something that would probably for ever remain inexplicable, viz, life. Turning next to the vegetable kingdom, the lecturer touched upon the physiology of plants, more especially indicating their methods of acquiring nutriment and the processes whereby respiration is effected. Slides illustrative of Mr. Dobb's remarks were shown, among which were *dionæa muscipula* (Venus' catchfly), *orchis maculata*, *ficus indica*, and *rafflesia arnoldi*.

WELLS NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.—At the March meeting a paper was read by the Rev. H. Winwood, M.A., of Bath, entitled "A Geological Ramble," Dr. Livett (vice-president) occupying the chair. The lecturer proceeded to give a very interesting sketch of the geological history of the Mendip Hills. These, he said, had a story to tell which at present had only been written in part; they contained many problems yet to be solved. The lecture was rendered the more attractive by a number of excellent coloured diagrams, and was listened to with great interest throughout. Two very remarkable diagrams were hung upon the wall. These were enormously enlarged *facsimiles* of sections of grains of oolite—one from the oolite of the Cotswolds, and the other from Clifton. These showed that the centre was largely composed of closely-packed worm-like organisms, though until quite recently nothing of the kind was believed to exist. At the close of the lecture Mr. Hippisley gave particulars of remarkable tilting of the coal measures at Camerton and Vobster; at the former place the strata had been tilted up, broken, and then overlapped, while at Vobster the strata had been tilted up and broken, and one half actually turned over completely on to the other, so that the lower stratum was on the surface. Mr. Winwood remarked that he well knew the district to which Mr. Hippisley alluded; the strata could be traced from their inclined to their vertical position, and onwards till they were completely overturned. The cause of this was by no means settled among geologists; various theories were entertained, but none of them were altogether free from objection.

WARWICKSHIRE NATURALISTS' AND ARCHÆOLOGISTS' FIELD CLUB.—The annual meeting was held at the Museum, Warwick, on March 24th, when the presidential address was delivered by the Rev. P. B. Brodie, M.A, F.G.S., who briefly reviewed the progress of science during the past year, and stated that many important discoveries had been made. Amongst these he especially drew attention to the important though long-predicted discovery of coal under the cretaceous and jurassic rocks near Dover. Mr. W. Andrews, F.G.S., read a short paper on the blue slate in the Cambrian rocks in north Warwickshire. At Atherstone they are at least 2,000 feet thick, and the coal measures overlie them unconformably. At Snow Hill, not far from Harts Hill, these beds, dipping at an angle of 54°, of both soft and hard slaty shales were exposed, the latter about three feet thick, and the only place where such hard slate had been previously found. Fossils were rare, but portions of oleni and two species of agnostus had been met with, one of which, an entire specimen discovered by the Rev. T. Potter, appears, according to Mr. Brodie, to be Agnostus Dux. Mr. Andrews thought that these Cambrians were more nearly related to the Charnwood Forest rocks than had been hitherto supposed. The hon. secretary (Mr. W. G. Fretton, F.S.A.) read a paper on "The Warwickshire Feldon," which, he explained, meant an open country not included in the Forest of Arden. He gave a sketch of its hills, valleys, rivers, trees, and general physical features, and a detailed account of the archæology of the district, including many interesting facts connected with it. The president then read a paper on "Fossil and Recently-Extinct Birds," illustrated by enlarged drawings. He began by alluding to the value and importance of living birds, and observed that, while their number and variety were very great, it was only of late years that remains of

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fossil birds had been recorded. If, which was doubtful, some of the bird-like footprints in the new red sandstone of Connecticut, in America, were correctly referred to aves, this would be the oldest formation in which they had been detected. But it would seem that at present the earliest known bird is that remarkable one having reptilian affinities, the archæopteryx, in the Jurassic lithographic stone, so rich in animal remains, at Solenhofen, in Germany. The structure and peculiarities of this strange avian form were explained. The sacrum of a small bird was described by Professor Seeley from the Wealden, in the Isle of Wight. Naturally, birds in a fossil state must be expected to be very rare; and as yet none had been observed in deposits where, perhaps, they were most likely to be met with. In America, Professor Marsh discovered about twenty species and nine genera in the cretaceous rocks; these were described by the author of the paper. In England, in the greensand at Cambridge, the humerus, tarsus, femur, and sacrum of two species of birds had been described by Professor Seeley, and are now preserved in the unrivalled local collection in the Woodwardian Museum. Other avian remains in British strata were referred to—the wingless wading bird, gastornis, from the lower eocene at Croydon; the small web-footed bird, with probable teeth, the odontopteryx, the skull of which was found in the London Clay at Sheppey. In the Bembridge limestone in the Isle of Wight feathers of birds were preserved. At Montmartre, near Paris, in Auvergne, and many other places abroad a great variety of birds had been recorded in the older and later Tertiaries. In the oligocene epoch some of these differ but little from recent ones, but more belong to extinct genera. These were fully described, and a detailed account given of the various strata in which they occur. A description was then given of the extinct birds of New Zealand, Madagascar, and the Mauritius, illustrated by enlarged drawings of the dinornis, the great rail, and the dodo. Mr. Whitley read a paper entitled "Notes on Shakespeare and the Warwickshire Parliament Members of his Day." The hon. secretary alluded to the interesting discovery of the site of the ancient priory at Kenilworth, where the greater portion of the west end of the lower part of the church had been found, and it was proposed to continue the investigation under the direction of the Society of Antiquaries. The general business of the club was afterwards transacted, the meetings for the year fixed, and the members dined together, as usual, at the Woolpack Hotel.

Reviews.

The Journal of Microscopy and Natural Science. Edited by Alfred Allen. [Bath. April, 1890.]—This journal is now the combined organ of the Postal Microscopical and the Wesley Naturalists' societies, and is published quarterly. The present issue contains several papers of interest to microscopists, with some well-drawn plates, illustrating Mr. Tuffen West's "Half-Hours at the Microscope." Mr. C. Rousselet describes a new tank-microscope of ingenious though simple construction.

Meteorology of Sheffield, 1887-9. By E. Howarth, F.R.A.S.—Students of meteorology will be indebted to the energetic curator of the Weston Park Museum, Sheffield, for his admirable compendium of weather statistics during the last three years. Diagrammatic tables are given showing the barometric and thermometric results and principal meteorological conditions on each day of the year, and these are accompanied by fuller descriptive remarks, which will form a valuable record for future reference.

Nature Notes. Edited by the Rev. Percy Myles, M.A. [London: H. Southeran and Co. Jan., Feb., March, and April, 1890.]—The opening numbers of this new journal of the Selborne Society show a healthy tone, and are replete with interesting notes and articles on natural history subjects, in which we observe ornithology takes a large share. Professor Boulger enters an eloquent protest against the persistent efforts of the conservators of Epping Forest to plant fir to the entire neglect of hornbeam, the most characteristic tree of the forest.

The Optical Magic Lantern Journal continues to provide an excellent *resumé* on the progress of lantern manufacture and lantern work adapted to various educational and other needs. A description is given in the April issue of the "Photoramic Camera," which is to revolutionise lantern exhibitions in the future.

Lancashire and Cheshire Entomological Society. Anuual Report, 1889.—This active society is enabled to record satisfactory progress during the session. The address of the president (Mr. S. J. Capper, F.L.S.) is printed in full, and there is added a list of all the papers read before the society since its inauguration in 1877.

A Technological Dictionary of Insurance Chemistry. *By Wm. A. Harris, F.R.S.S.A., Secretary, Phœnix Fire Office, Liverpool.* [Published by the Author.]

This is a work which should prove of great value to all interested in fire and marine insurance. It contains correct and useful information upon nearly every substance that may have to be stored in warehouses and other places, carried by rail, on board ship, or in other conveyances, and should be of great assistance to insurance surveyors, agents, and others in deciding upon the risks involved in insuring under various circumstances. Different processes of manufacture are also alluded to so as to indicate the nature of the risks they entail, and much information is given respecting natural processes, such as oxidation, leading to the production of increased heat and possible production of fire. There are also useful articles on the heating arrangements of buildings, ships, &c., which have an important bearing on the inflammability of goods stored near them, and many other topics intimately connected with fire insurance risks are dealt with in a clear and comprehensive manner. It is evident that Mr. Harris's training and experience have qualified him in an eminent degree to collect and put into shape information on insurance matters which renders his book one of the most serviceable that insurance men can study; it should also prove interesting and useful to brokers, merchants, and others who wish to become acquainted with the characters and uses of the various articles of commerce in which they deal.

Biology. *By Dr. Charles Letourneau.* [Chapman & Hall, London, 1890.]

Twelve years ago this work first appeared in the English tongue. The "new edition" is simply a reprint of the former, with the correction of some three errata. The book occupies some 480 pages and has 83 illustrations, and the author says in the preface—"We have simply attempted to state concisely what life is, and how organised beings are nourished, grow, are reproduced, move, feel, and think." "We do not write for scientific men; we wish especially to be read by the mass of enlightened people whom our very incomplete system of public instruction has left almost unacquainted with Biology." The author takes exception to the scientific man on the one hand because he narrows himself to the limited horizon of his laboratories, and to the pseudo-scientific individual on the other, because he does not sustain the dignity of the most dignified of the sciences. To be perfectly candid we heartily sympathise with these views, but, after careful examination of the pages of this work, we ask ourselves the question—Where is the "mass of enlightened people" to be found to read a work like this? In the first place the translation is most unsatisfactorily done; the translator appears to have been sadly wanting in a knowledge of suitable equivalent expressions for the large number of technical terms used by the author; hence we have a perfect mongrel phraseology and terminology running throughout the book. The following are a few examples taken at random:—Asexuate, sexuate, segmentises, scissiparous, hermaphroditical, sarcodical, amibiform, vorticels, &c. Ch. I. Book IV., "of the origin of organised beings" is replete with the unadulterated spontaneous formation theory. "The Darwinian doctrine demands as its indispensable complement spontaneous formation, without germs, without parents, of the first examples of the living world," so argues the author by selections from experiments by Pouchet, Pennetier, Mantegazza, and others which have been so thoroughly exposed by Tyndall, Huxley, Dallinger, &c. As a text-book it cannot be recommended, but to the student of Biology it might furnish some useful information, although much cumbersome reading will have to be gone through before the "grain" is secured.

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The Naturalist. [Leeds: April, 1890.]—Among the contents of this number is an appreciative memoir of the late Mr. S. A. Adamson, F.G.S. (from the pen of the Rev. E. Maule-Cole, M.A., F.G.S.) and an instalment of the Geological Bibliography for 1888, the preparation of which was one of the last pieces of work undertaken by that gentleman.

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Journal of Conchology. Conducted by John W. Taylor, F.L.S. [Leeds: Taylor Bros. Oct., 1889., Jan., Apl., 1890.]—These three numbers have all been issued this year, and their contents are of the usual high standard. Perhaps the most interesting contribution is that of Mr. J. Cosmo Melvill, on "British Pioneers in recent Conchological Science."

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A CATALOGUE OF BRITISH FOSSIL VERTEBRATA. *By A. S. Woodward, F.G.S., and C. D. Sherborn, F.G.S., pp. 396, xxxv.* [London: Dulau & Co., 1890.]

PALÆONTOLOGISTS will welcome the appearance of this valuable index and guide to British vertebrate fossils, which is an advance upon previous works of a similar character, and one upon which, when the difficulties of its compilation are considered, the authors may well be congratulated. The earliest work of reference of the kind was Samuel Woodward's "Synoptical Table of British Organic Remains," published in 1830, in which the entire enumeration of the known British fossil vertebrata was comprised in *two pages!* From that time to the present, successive Indices have been enlarged to make room for our rapidly-extended knowledge, and no more striking testimony to the progress of palæontological research can be found than in the fact that, sixty years after Woodward's first attempt, the catalogue of the vertebrates has reached the goodly proportions of the present volume. In the introduction the authors appear to apologise for restricting their lists to Great Britain, but the history of palæontology is really epitomised in Britain, and though in some groups our fossil remains are scanty and fragmentary, yet, as a whole, there is no other area of equal extent in which greater variety is displayed. The principal discoveries of fossil vertebrates are recorded in a descriptive chapter preceding the catalogue proper, and full particulars are given of the localities of the more important collections. In the catalogue, the genera and species are arranged alphabetically under their respective classes, and all generic and specific names are printed in antique Roman type. When ascertainable, the nature and present whereabouts of the type specimen of each accepted species are stated after the record of the locality. In an age when the useless multiplication of names is too often extended to alarming proportions (a single University Museum being referred to, which is responsible for no fewer than seventy meaningless terms among the Reptilia alone), it is of considerable service to have at hand a list so carefully prepared giving the authoritative names of the various fossils known. The book is well printed, and the type well selected for convenience of reference. It will be simply invaluable for curators and for the working palæontologist. The full references to memoirs and publications in which the specimens are described, or their discovery reported, are particularly useful.

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Transactions of Societies.

Journal of the Liverpool Geological Association, Vol. ix. Session 1888-89.

GEOLOGY is evidently a favourite study in Liverpool, and the devotees of the "stony science" do not diminish in the ardour of their pursuit. The present, which forms the ninth annual volume issued by this association, shows a goodly record of work for the year. It is satisfactory to find that a considerable share of attention is given to local topics, as witnessed by the well-written reports of the several excursions, and by papers on the building stones used in Liverpool, and at the Birkenhead Priory, by Mr. J. Wilding, and by Mr. J. Hornell's researches into the obscure life-history of the classical *Labyrinthodon*. Mr. H. T. Mannington's note on a calcareous deposit near Flint, and the note by the hon. secretary (Mr. I. E. George) relative to Manx lavas, also touch upon subjects within what may be termed the local area; while Mr. P. F. Kendall's description on the geology of Mull, Mr. W. D. H. Deane's paper on "Meteorites," and that by Mr. W. Hewitt, on "The Evolution of the Grand Cañon of the Colorado," afford evidence that studies farther afield are not neglected. Mr. D. Clague, F.G.S., describes a new form of goniometer of ingenious construction, which is an exceedingly useful adjunct to the mineralogical class-room.

THE last instalment of the *Proceedings of the Berwickshire Naturalists' Club*, containing nearly 300 pages, consists for the most part of "A List of the Marine Algæ of Berwick-on-Tweed," by Edward A. L. Batters, and an interesting report of the meetings for 1888, by the energetic secretary of the club, Mr. James Hardy.

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Transactions of the Manchester Geological Society. Parts xiv.—xvii. Session 1889-90.

A USEFUL feature in the publication of this society is the attention which is always given to mining, and especially to matters connected with the most important mining industry of Lancashire. Professor E. Hull, F.R.S., contributes a paper on the probable average depth to which coal is now being worked in the British Isles, in which he discusses several questions in regard to the progress of exhaustion of our coal fields. This paper gave rise to an exhaustive discussion, which was continued at the subsequent ordinary meeting, and is fully reported. Mr. R. Walkden describes a fossil stigmaria found in a mine at Over Darwen, and Mr. H. W. Williams brings under notice the county of Pembroke as a field for the study of geology. The paper by Mr. Mark Stirrup on "The Hydrology of the Causses of Languedoc" is an able description of a region of wonderful interest to the student of sub aerial denudation, but only too little known to the ordinary traveller. Mr. Thomas Ward, J.P., the eminent authority on salt, gives a valuable paper on the salt deposits of the United States and Canada, the result of a personal tour of inspection which he recently undertook. The deposits of this mineral in America are of enormous extent, and belong, it would appear, to different geological ages.

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Letters to the Editor.

PRESERVATION OF BIRDS.

SIR,—In *Research* for April 1 notice a paragraph in respect to the extension of the Wild Birds' Protection Act to birds' nests and eggs I hope before persons sign any petition in favour of such an object they will consider the following points:—

The Birds' Protection Act protects grannivorous birds as well as insectivorous ones, and that, besides the large quantity of grain eaten by the former, some of them, as the sparrow, drive the insectivorous birds away; and to such an extent do the grain-eating birds increase, even under the present Acts, that the farmers have to band together and offer rewards for their destruction. This, I think, is worse than if we had no protection at all. The sea-birds, on some parts of the coast, have so much increased that the small quantity of fish left after the birds have taken what they want will not pay the fishermen for catching, and the men have had to find something else to do.

The Acts only protect the common birds, while the rarer ones, which are the ones that require protection most, are destroyed nevertheless.

The gun license, I think, is a sufficient protection for all common birds, and the rarer ones cannot be protected until "naturalists" cease to offer rewards in the shape of fabulous prices for their destruction.

The Acts make it impossible to procure birds (unless they are poached) in certain stages of plumage, and some birds cannot be obtained at all. No new collections or museums can be started with any idea of making a complete collection of British birds, and, if we conform to the Acts, the science of ornithology, so far as Britain is concerned, must stand still. Whether is it of more importance that students of bird-life should be able to procure the materials for study, that the farmer should be able to house his grain, and the fisherman haul his fish, or that the sentimental bird protector should have his own whims gratified? I love the birds and would protect them all I could, but through the school and not through Parliament is the way to do it. S. L. MOSLEY.

Beaumont Park Museum, Huddersfield.

[Does not our correspondent somewhat exaggerate the fish-destroying powers of sea birds on the coast?—ED].

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Publications Received.

A Technological Dictionary of Insurance Chemistry, by W. A. Harris, F.R.S.S.A., (2nd edition); *Thirteenth Annual Report of the Lancashire and Cheshire Entomological Society; Third General Report of the Bootle Free Library and Museum Committee; Meteorology of Sheffield, 1887-89*, by E. Howarth, F.R.A.S.; *A History of British Birds: their Nests and Eggs*, by S. L. Mosley; *Natural History Journal*, March and April. The following publications for April:—*John Hopkins University Circulars; Optical Magic Lantern Journal and Photographic Enlarger; Naturalist's Knowledge; Brewer's Journal; Microscope; Nature Notes*; and *Naturalists' Guide.*

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Research:

A MONTHLY ILLUSTRATED JOURNAL OF SCIENCE.

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Discontinuance of "Research."

THIS number completes our Second Volume, and with it, we regret to add, *Research* will cease to appear.

The Journal has, during its existence, met with a large amount of support, and we most cordially thank all those who have rendered us their assistance. Still, this support was not sufficiently large to ensure its thorough success financially, and the Editor being desirous of lessening those of his engagements which are outside his own private professional work, it has been decided not to continue the publication, and we now, therefore, regretfully bring it to a close.

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Bees and Flowers:

AN EXAMINATION OF THE THEORY OF THEIR SELECTIVE ACTION.

BY G. W. BULMAN, M.A., B.Sc.

I PROPOSE to examine here, in the light of my own observations on the habits of bees, the theory of their selective action in the evolution of flowers. This theory is so well known that I need not stop to give more than the briefest outline of it. I shall speak of it for shortness as "the theory." It seems first to have received definite form in the hands of Darwin and H. Müller; more lately it has been largely and ingeniously developed by Sir John Lubbock and Grant Allen.

Among the numerous spontaneous variations which are ever occurring among flowers, bees are supposed to select for their visits those best suited to them and to neglect the others. The former receive the advantages of cross-fertilisation, and consequently vanquish the others. By a process of living down those which have not varied, or varied in the wrong direction, the favoured variety attains the rank of a distinct species.

"Just as our gardeners by selecting seed from the most beautiful varieties have done so much to adorn our gardens, so have insects, by fertilising the largest and most brilliant flowers, contributed unconsciously, but not less effectually, to the beauty of our woods and fields."

This passage from Sir John Lubbock's *Scientific Lectures*, together with the following from Darwin's *Cross and Self-Fertilisation of Plants*, gives a clear idea of the sort of bee required to do the work of selection:—

"Florists may learn from the four cases which have been fully described that they have the power of fixing each fleeting variety of colour, if they will fertilise the flowers of the desired kind with their own pollen for half-a-dozen generations, and grow the seedlings under the same conditions. But a cross with any other individual of the same variety must be carefully prevented, as each has its own peculiar constitution." p. 460.

Keeping this bee in mind I shall now endeavour to give a sketch of the bee of nature, as it has appeared to me during a series of scattered observations. First, then, the question of colour. Bees are said to prefer blue and red to other colours; the former is the latter development and their special favourite. They are supposed to have developed various species of blue flowers from those of other colours by their selective action. I am not aware that this idea of the bee's preference for blue has arisen as a deduction from its habits with regard to flowers: at any rate I shall endeavour to point out that it shows no decided preference of the sort; and it is quite obvious that for bees to develop a race of blue flowers from any other colour they must show a very decided preference, and exercise it perseveringly for many generations by selecting those approaching the desired hue.

In the first place there are many flowers of other colours quite as much visited. What blue flowers, for example, are more frequented by bees than the flowers of the lime tree, willow, broom, whin, white clover, pear tree, &c.? And they may be seen to go to yellow and other colours when blue is close at hand. I have seen them pass over sweet violets to get at yellow crocuses and white snowdrops; and in a border containing *Tropæolum nasturtium* and *Convolvulus minor* I have many times seen bees on the former when none were on the latter; and, in my experience, there are many blue flowers very

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little visited. In this category I place periwinkle, lobelia, harebells, *Convolvulus minor*, and *Nemophila insignis*. There are also many brilliant red flowers which are not by any means favourite, *e.g.*, scarlet geranium, *Linium grandiflorum*, and scarlet poppies.

It is interesting to note the conduct of the bees when different colours of the same or different species grow together. On two occasions I watched particularly those which came to some mingled blue and white campanulas of the same species; both times a larger number went first to the white than to the blue. Another time I saw in a few minutes six bees pass from blue campanulas to white syringa. I have also observed bees go straight from the blue flowers of lavender to white, pink, and yellow blossoms. And the fact that the bee of to-day, in the midst of flowers of various colours, will visit green flowers for honey seems in itself sufficient to throw grave doubt on the theory. One or two examples may be given.

The plane tree is often visited by crowds of bees. It is not only Coleridge who has observed the

"Sycamore oft musical with bees."

Many may also be seen at times on the green flowers of the red currant, and, according to the author of *Bees and Bee-Keeping*, this plant depends for the setting of its fruit upon the visits of the insect. If this is so it must be abundantly visited, as it is, perhaps, the surest of our fruit crops. And in Müller's *Fertilisation of Flowers* we find the record of a plant with greenish, inconspicuous, and scentless flowers being visited all day long by bees. If, then, the bee of the present day visits at times uncompromisingly green flowers, can we suppose that its ancestors, in the time when a whorl of green leaves round the essential organs represented the blossom, would *select* those with a slight tinge of yellow, red, or blue, and neglect the purely green ones? Or can we believe that a bee which after feeding on a blue flower will fly straight to a white or yellow, which passes with seeming indifference from red to white or yellow, will exercise that discriminating taste necessary to keep a new variety of colour from blending with the main stock, and thus being lost?

Then, with regard to form: can we suppose that they carefully select those varieties offering a slight advantage and neglect the others? I have seen no indications of any such discriminating taste. I have frequently seen them pass from the simple regular flowers of wild geraniums to the utterly dissimilar blossoms of *Linaria cymbalaria*. I have seen them pass from foxglove to snapdragon, again utterly dissimilar in form.

Again: such flowers as *Anterrhinum majus*, *Vicia sativa*, *Erica*, &c., are supposed to be the outcome of the insect's selection of those flowers which suited it best. But how does it show its appreciation of flowers which offer it such conveniences for alighting and thrusting in its proboscis? In very many instances it goes to the base of the flower, bites a hole, and extracts the honey from it! Surely we cannot suppose it cares much for the *form* of the flower when it acts thus.

The fact that it will, when honey or pollen is to be obtained, visit flowers which have lost all their petals seems also to show that the shape of the flower is not of paramount importance. I first noticed this on a little patch of *Geranium phœum* in a garden. During perhaps half an-hours's watching I counted seventeen visits to petal-less flowers. I have since found that Darwin has observed it on the same flower.

I have also seen bees visit flowers of *Geranium pratense*, cistus, bramble, and sage which had lost their corollas, and on a species of campanula I observed on one occasion several visits to flowers which consisted merely of little brown masses of their withered corollas resting on the tops of the growing ovaries.

On another occasion I noticed a very abnormal flower of a single dahlia. It was formed by the union of two imperfect flowers, and presented a very different appearance from the ordinary symmetrical blossom. It was visited four times by bees while I watched it.

Then how often may bees be seen visiting double pinks, daffodils, roses, and other abnormalities of the florist; while exotic flowers quite different to any they have been accustomed to, are likewise often freely visited.

Consider the enormous variety in the forms of the flowers a given species of bee will visit—the simple regular flower of the wild geranium, the irregular labiate, the bell-shaped campanulas and heaths, the lipped and closed antirrhinum and linaria, the strangely irregular orchid. Can we believe that the ancestors of this bee, so catholic in its tastes, would carefully select certain small differences in form and neglect others? And the reason which is given for the bee of to-day visiting a large number of the same species together, viz, economy of time, would hardly hold in the case of the slight variations—embryos of future species—with which its ancestor was concerned.

Another important fact is that bees often go to flowers which are quite unsuitable for them. Thus, Müller records that they will try to extract honey from flowers which contain none, and from others in which it is beyond their reach.

Again: the fully-expanded flowers of *Compositæ* or *Dipsaceæ* are symmetrical wholes; but observe a bee among them. It goes to a fully-opened flower, and then to one with only two of its florets expanded! This latter is in form totally different from the former; the bee seems to make no distinction. Usually the bee goes to the front of a flower, but sometimes it will take it from behind, whence it presents a totally different aspect. And when the flowers of a species of mallow close in the afternoons, Müller tells us the bees will come and take the honey from the outside!

Taking these facts into consideration, we can scarcely suppose that the result of the bee's selection will be the development of a race of flowers of any special form.

And, supposing the question of taste was settled in favour of the theory, there is another difficulty. The new variety which is to become a species appears first as an individual or a few such. Honey and pollen are a vital necessity to the insects, and they are unable to get sufficient from these few; they are obliged to give others the same advantage, as well as to cross the new variety with them.

The question has been asked—Why, supposing blue is the favourite colour of bees, and that these have played the most important part in the evolution of flowers, are there not more blue ones? Sir John Lubbock's answer seems to imply that there has not yet been time, and that their superiority is a thing to be attained in the future. It appears to me, however, that, in accordance with the principles of the theory, blue ought rather to be a mark of superiority already acquired than a prophecy of future success. By the time the blue colour is developed and stereotyped the plants have had the advantage in the struggle for existence for many generations, and ought to have lived down their less-improved relations and become the most numerous in their family.

Grant Allen, in his *Colours of Flowers*, gives incidentally a different answer. He speaks of the more advanced *Compositæ* as having passed the blue stage and become yellow again. Such a process will evidently account for the want of numerical superiority in blue flowers. But it involves one of two suppositions. Either (1) that the bee's taste changed, and that it began to select those flowers which showed a shade of yellow; or (2) that it altogether neglected these blue *Compositæ*, and that some other insect with a taste for yellow—say beetles—took them in hand. The first involves the assumption of a rigidly-exercised taste for yellow and neglect of blue in bees descended from azure-loving ancestors; it simply gives us two unwarrantable assumptions as to the bee's taste instead of one. The second involves the assumption that, while there are still too few blue flowers to supply the needs of the bee, it has persistently neglected many of the same for many generations,

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It is interesting to note in this connection that both Müller and Grant Allen credit the bee with forsaking its favourite blue for yellow in special cases. According to the former, yellow has been evolved from purple by its selective action :—

"The sulphur-yellow colour of *Sempervivum Wulfenii* seems not to stand on the same rank as the yellow colour of some *Sedums;* but rather to have been developed from a purple colour by the selective influence of bumble-bees."

And the partially yellow wild pansy according to the latter is the result of the bee's selection on a flower once all blue :—

"We can hardly resist the inference thrust upon us by analogy—that the pansy was once all blue, and that the yellow has been developed here, as in the snapdragon and the ivy-linaria, to guide the bees to the proper place for securing the nectar and effecting cross fertilisation."

In all the attempts to show how a race of blue flowers may have been evolved by the selective action of bees there seems to me a strange fallacy. The bee's taste for blue is said to have arisen from the fact that those flowers best suited to it are blue : it is the result of experience. Now it is quite conceivable that a bee launched into a world of flowers where all those with most honey and of most convenient form were blue would learn in time to prefer these. But this implies the pre-existence of blue flowers. The bee which is to develope the first blue flowers cannot be supposed to have taste acquired in this way. Suppose, on the other hand, that the bee starts in a world where no blue flowers have as yet appeared. If it learns as before from experience it will get to prefer some other colour ; a taste for blue independent of experience is required before the bee can be of any use in this case. The fallacy arises from the indiscriminate use of these two bees. For the development of blue flowers a bee already possessing a taste for blue is assumed ; for the development of the bee's taste pre-existing blue flowers are assumed. The mutual development of colour and taste is made plausible by speaking of these two bees as if they were the same.

The constancy of the bee to one form and colour of flower during a single journey is of obvious importance to the theory. If they fly from one "incipient species" to another they will tend to retard development and differentiation by constant intercrossing.

Do their habits at the present day, then, warrant us in assuming the necessary constancy in time past? That they do exhibit a certain amount of constancy is well known. As Darwin notices, the constancy of the hive bee was observed 2,000 years ago by Aristotle. He expresses his own opinion as follows :—

"All kinds of bees and certain other insects usually visit the flowers of the same species as long as they can before going to another species."

He adds, however, that the habit is not invariably followed, and records that he has found pollen of Œnothera within many flowers of *Mimulus*, *Digitalis*, *Antirrhinum*, and *Linaria*.

Müller expresses his opinion thus :—

"The most specialised, and especially the gregarious bees, have produced great differentiations in colour, which enable them on their journeys to keep to a single species of flower."

And yet he mentions several cases of bees passing freely from species to species, as from *Ranunculus bulbosus* to *R. repens*, from *Trifolium fragiferum* to *T. repens*, and from blue hyacinths to blue violets. For my own part, since first noticing a few instances of changeableness, I have seldom watched for more than a few moments without seeing fresh examples of it. I conclude on the whole that they show less constancy than is generally supposed, and certainly much less than is required by the theory ; and if the bee of to-day, with all the existing differentiation of form and colour, does not always restrict itself to one species, surely much less would the bee of time past restrict itself to any particular slight variation or "incipient species."

It is well to note with regard to Müller's expression of opinion given above that it is the differentiations in colour, which they themselves are supposed to have evolved by their selective action, which enable them to keep to one species ; and, further, that bees do not seem to make any particular distinction between different colours of the same species. As Darwin observes :—"Humble and hive bees are good botanists, for they know that varieties may differ widely in the colour of their flowers and yet belong to the same species. I have repeatedly seen humble-bees flying straight from a plant of the ordinary red *Dictamnus fraxinella* to a white variety, and from one to another very differently-coloured variety of *Delphinium consolida*, and of *Primula veris;* from a dark purple to a bright yellow variety of Viola tricolor, and with two species of *Papaver*, from one variety to another which differed much in colour."

The whole theory rests on the facts as to the effects of cross and self-fertilisation. Are, then, these facts such as to render the bee's action in cross-fertilisation an efficient factor in the evolution of new species of flowers? The question is too large a one to enter fully into here ; nor do I wish to throw any doubt upon the advantage of occasional crossing among flowers. I have always been a firm believer in its benefits. I shall, therefore, only point out one or two particulars in which the facts do not seem to meet the requirements of the theory. In the first place, accepting Darwin's conclusions fully, it has not been shown that *very frequent* crossing is more advantageous to a race of flowers than an occasional cross ; and for the development of a race perfectly adapted for cross-fertilization only it is necessary that this should be so—it is, in fact, what is *assumed* in all attempts to trace such development by the selective action of insects.

And there are some facts pointed out by Müller in his *Fertilization of Flowers* which indicate that it is not so. There are certain species of flowers which are at the same time the least visited by insects, and the most numerous of their genus. Thus, of *Veronica hederæfolia* he writes :—

"The small, solitary, pale flowers are less conspicuous than those of any other species described here ; they are very seldom visited by insects, but almost without exception bear good seed, and the species is one of the commonest of its genus. The presumption that this results from self-fertilisation is increased by watching the plant when protected from insects."

And of the Polygonums :

"Finally, in *P. aviculare*, whose flowers are not only much smaller but are solitary and devoid or almost devoid of honey, insect visits and consequent cross-fertilisation are only the exception ; yet this species is with us the most abundant of its genus and one of the commonest of our native plants."

It is suggested by both Darwin and Müller in their experiments and observations that by continued self-fertilisation a plant becomes more fertile to the same. Darwin's experiments certainly do not tend to show that self-fertilisation becomes more and more disadvantageous in future generations, so that self-fertilised species would gradually die out. Yet he seems to have felt that it was important for his theory that it should be so, for one of his reasons for wishing to live a few thousand years was that he might see the extinction of the bee orchis, to which he believed its habit of self-fertilisation was leading it.

Another fact which renders cross-fertilisation rather a hindrance than a help to the theory is clearly brought out in Darwin's experiments. He has shown that for the isolation of a new variety cross-fertilisation is to be avoided. This was brought out, as we have seen, in his experiments on *Ipomœa* and *Mimulus*. It has also been shown that seedlings from a cross between slight varieties are the most vigorous, and these crossed seedlings will at the same time be those in which the tendency to depart from the original type has been checked.

Some Popular Lunar Weather Superstitions.

OF the many popular beliefs prevailing in Northern Europe with reference to the coming weather, there is one which only quite recently has been proved to have some substance in fact, viz., the farmer's fear of the so-called "ice men"—the "severe masters," Momertur, Panciatius, and Servatius, of the Romans, who are said to cause frost on May 11, 12, and 13. Recent meteorological researches have proved

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that the number of frost-nights really increases towards the middle of May in Northern Europe, and then again suddenly decreases. From the position of the sun at that season, we should naturally conclude that this would not be the case; but recent observations have fully proved that at this period of the year a peculiar division of atmospheric pressure is formed over central Europe, which undoubtedly causes cold air currents. How this abnormal division of pressure is caused is, however, still a riddle; but, in any case, the farmers would have had many a field of corn nipped by the frost had they awaited the scientific demonstration of this fact. For the reason that the number of frost nights increases alarmingly in the first half of May, the farmers in Northern Europe also fully believe that the light of the moon is at that time very injurious to the young corn. They believe that the moon then "emits cold," killing the young plants. In some parts of Northern France, the peasants call the May-moon *la lune rousse*, because the corn assumes a dirty russet colour when touched by the frost. In reference to the *lune rousse*, it is said that Louis XVIII. once asked Laplace what connection there was between it and the cold which killed the corn, and that the famous astronomer, who had never heard of *la lune rousse*, answered gravely:—"Sir, *la lune rousse* does not belong to the *theoretical* astronomy, and I am therefore unable to satisfy your Majesty's curiosity." However, the "cold" May-moon is accounted for thus:—The observation has been made that cotton wool, down, and similar soft fibrous material, when exposed in the open on moonlight nights, attain a lower temperature than the air around; for instance, if a thermometer is suddenly transferred from the latter and placed in such material, it will sink from 4° or 5° C. to freezing point. This phenomenon is explained by the circumstance that the fine fibres of the wool discharge their own heat much quicker than a large, solid body, the surface of which, in proportion to its cubic contents concentrating the heat, is much smaller than that of the wool. Similarly, when the sky is cloudless the heat from the earth has free passage into space, which is cold, and therefore absorbs the heat, whereas when the sky is clouded the clouds retain the heat and no radiation takes place.

The earth, which in Spring has become warm during the day, is again chilled at night, and envelopes itself in the warm clouds; but the young plant, which during the day has unfolded its tender fibril leaves under the influence of the warm rays of the sun, corresponds with the fine wool, and must therefore during the night give out the heat absorbed during the day much quicker than the surrounding air. The inner temperature of the plant may therefore sink below that shown by a thermometer placed by the side of it, and thus freeze. But this can, as shown, only occur when the sky is clear, *i.e.*, when the moon is wholly unobscured. This is the dreaded effects of the May-moon, which, however, is not, as the farmer concludes, the cause, but only the accompaniment of the cause. Peasants in Northern Europe often attempt on moonlight May nights to prevent the young corn from being frozen by lighting bonfires in the fields, and with considerable success, but from a different cause from that assumed by them, viz., that the temperature of the air is raised thereby. The true cause is that the smoke from fires, distributed over the fields on the plants, acts like the clouds on the earth, viz., prevents radiation. It is important to point out that the reason why this phenomenon particularly occurs in early May in preference to other months, is that at that period an abnormal atmospheric condition prevails in these regions, as stated above, and that the young plants are then more sensitive. Later on the temperature rises rapidly day and night, and the plants become more hardy.

As regards the influence of the moon on the weather, of which most country people are so convinced, there exists, in reality, no scientific proof of warranting such an asssumption. Certainly, a change of the moon may sometimes be accompanied by change of weather, and this has, no doubt, led people who are always anxious to put cause and effect together to endorse this old-world's fallacy. In all such cases the instances which go to prove the cherished theory are recorded, but those disproving it are not recorded. The most careful observations in recent times, extending over a long period, tend to show that the influence of the moon on the weather is very small. In fact, the moon exercises so little influence on either the barometer, rain, or wind that it is impossible with the instruments at our disposal to demonstrate any such within a period of 20 years. In spite of this, nobody denies that the moon exercises some influence on the *atmosphere*, similarly to that exercised on the sea, but in the former case the influence is far less than in the latter. The change in the weather to be predicted from this influence is so small that the barometer from careful observations has only shown a variation of two hundred parts of a millimetre. It may naturally be asked how it is that the moon, which has such a tremendous influence on the sea, leaves the mobile air untouched; but on reflection the answer is simple enough, viz., that it is due to the difference in their physical nature. For the very reason that the air is so easily set in motion, an aërial wave caused by the attraction of the moon will be unable to sustain itself long or with any great force in a given direction. The atmosphere being very expansive, the equilibrium will soon be restored; moreover, whatever influence the moon exercises on the air, such influence is always *gradual*, not violent. In fact, whatever the popular belief may be on this point, scientific research does not endorse it.

There is another popular fallacy to touch upon, viz., to use the words of the peasants in Denmark, that the moon "eats the clouds." We have all watched how the full moon appears to become covered with clouds, battles with them, and finally seems to disperse them; but here again the cause is the same as that maintained before, viz., that whilst the portion of the sky which is illuminated by the moon attracts our eye, and we note the apparent cause and effect with an innate desire to confirm an old-world theory, we entirely omit to pay attention to the changes of the clouds, of quite a similar nature, which take place in other parts of the sky. At all events, chronological observations do not tend to show that the moon remains longer out of than behind clouds. But let us even see whether such an influence is explicable theoretically. It has been admitted that the changes of the moon may have a very small effect on the weather through a kind of tide in the atmosphere, and, as regards the cloud-dispersing power of the moon, there may be two explanations to be considered. One is that just referred to, of a tide in the air, whereby an aërial wave should always follow the moon, and thus create a higher atmospheric pressure where the moon was highest in the horizon; but we know that a high atmospheric pressure has the effect of clearing the weather, *i.e.*, to disperse the clouds—not, however, as regards the particular clouds alone which happen to be in front of the moon, but *the whole sky in general*. As regards the other explanation, it deserves to be specially referred to in connection with this subject, as it touches upon the disputed point whether the moon transmits us any heat. The popular belief is, as shown by the superstition about the May moon, that the moon's rays contain no heat, and are, as it is expressed, "cold." That this is almost the case seems to have been fully demonstrated by the experiments of Tschiruhaus (with a thermometer on a large magnifying glass), and the more recent ones of Lord Rosse (by the aid of electricity), and finally by those of Professor Piazzi Smyth, on Pico de Feyde (Teneriffe), the observations of the latter tending to show that the heat emitted by the moon has less effect upon us than an ordinary candle placed at a distance of 15 feet. That such an infinitesimal amount of heat should have any dispersing effect on the vapours of the atmosphere does not admit of argument. It should, however, be mentioned that Herschel believed in the possibility of such an influence by an increased radiation in the upper strata of the atmosphere. Be this as it may, it seems quite certain that popular superstition ascribes a far too important *rôle* to the moon in reference to changes in the weather than is warranted by scientific observations.

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Another theory fully believed in by Scandinavians and hyperboreans, viz., that the moon arrests the play of the *aurora borealis*, has also recently been proved fallacious, chiefly through the researches of Dr. Sophus Tromholt. The light of the moon *outshines* that of the aurora, but does not *arrest* it.

In conclusion: it must, however, be said that the meteorologist would do well in inquiring into popular beliefs and superstitions as regards changes in the weather, as they may often put him on the track of solving many a local meteorological puzzle.

On Some Apparatus Designed by the Late J. W. Clark. *

MR. CLARK was first Demonstrator and afterwards Assistant Professor of Physics at the University College, Liverpool, some four or five years ago. Some of his devices it is probable he would have wished to publish had he lived. One of the subjects in which he was interested, through some work conducted at the medical school by Dr. Barron and others, was the incubation of disease germs; and for this purpose he arranged an incubator which worked very successfully.

The well-known process of germ cultivation is to first obtain fresh sheep's blood as clean as possible at the abattoir by inserting a tubular vessel into the gash; the vessel is then subjected to rapid rotation, whereby the serum of the blood, by the centrifugal force exerted, is separated from the red corpuscles. This clear liquid, serum, was then placed in numerous small test tubes, where it underwent a treatment that was supposed to kill all stray germs that it might contain. Every tube of this cleaned serum may then receive germs of specific disease.

Inoculation consisted in placing a minute drop of diseased blood in the serum; immediately afterwards the tubes were hermetically sealed and placed in the incubator.

The diseases studied and cultivated were typhus fever, typhoid fever, tuberculosis, and others.

Their successful cultivation demands a very *constant* and *uniform* temperature.

By constant temperature is meant a temperature that does not vary with time; while a vessel is said to have *uniform* temperature when the same temperature exists in all parts of it. Both of these conditions must be fulfilled in a perfect incubator.

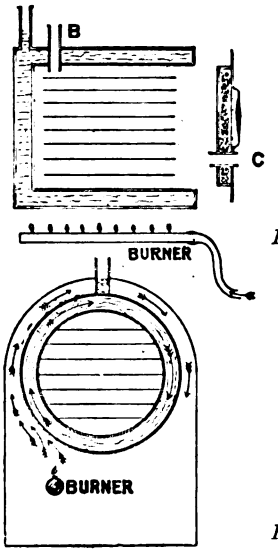

Fig. 1.

Fig. 2.

* A communication made by Dr. Oliver J. Lodge, F.R.S., President of the Liverpool Physical Society, at their meeting on March 24th. Reported by Mr. B. Davies.

The incubator designed by Mr. Clark was to give *uniform* temperature, while some appendages in the form of gas regulators were to maintain a *constant* temperature.

The form of the incubator is seen in *figs. 1* and *2*. It is made of two concentric circular cylinders of copper, with the annular space filled with water. The inner space is provided with shelves to hold specimens; the shelves are perforated to allow a free circulation of air throughout. The lid is also hollow, the space being filled with cotton wool.

The principle of it is that the conducting power of the copper tends to equalise the temperature at all parts, and the great mass of water prevents fluctuation of temperature from being rapid. The circular form was to promote circulation. Another idea of Mr. Clark's, but not yet put into practice, was to obtain uniform temperature by exhausting the space between the cylinders and filling it with water and the vapour of water. By keeping the lowest part of such a vessel infinitesimally warmer than the rest, almost instantaneous equalisation of temperature would take place throughout the space occupied by the vapour through the agency of evaporation and condensation. Thermometers are inserted to ascertain the temperature of the incubator, one for the upper portion, the other for the lower.

The flames were placed unsymmetrically underneath, the incubator being a little on one side, in order to set up a distinct circulation of the water in the annular space in the direction of the arrows. The incubator had a bright metal case surrounding it, shown in *fig. 2*, to protect the currents of hot air flowing around the incubator from being interfered with by external disturbances.

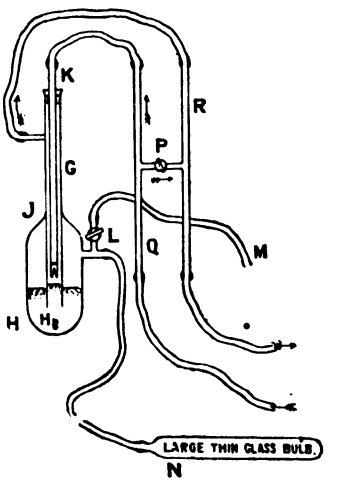

Fig. 3.

The gas for heating was supplied through the temperature regulator *fig. 3*, which consists of an external glass tube **G**, with a bulb **H** sealed on to it at **J**. Through a cork in this tube passes an inner glass one, carrying a small platinum tube slotted in a **V**-like manner, and which dips into the mercury placed in the bottom of the bulb. The surrounding tube **G** reaches the bottom of the bulb nearly. This apparatus was placed vertically near the incubator, the gas entering through the tube **Q**, and down **K**, up **G**, and out through **R**, thence to the incubator burner. Now the bulb **N**, having been placed in the water jacket, will feel any increase in temperature, and the resulting expansion of the contained air will depress the mercury in **H**, driving it up the tube **G**. This will cause a throttling of the gas at the platinum **V**, and produce a smaller flame under the incubator.

When the weather is getting colder the incubator cools itself infinitesimally, with a corresponding contraction of the air in the bulb. This contraction will immediately enlarge the **V** slot by depressing the mercury, letting more gas through, which will just give the additional

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amount of gas necessary to counterbalance the effect of the colder weather. When the weather again becomes warmer exactly the reverse process takes place. In cold weather, then, we have large flames; in hot weather small flames.

The tap **L** and the tube **M** are provided for adjusting the apparatus to regulate at *any* desired temperature.

Connecting **Q** and **R** is a bye-path through the tap **P**, which lets a very small quantity of gas direct to the burner without passing through the regulator.

If it ever happens that the rise of temperature is so sudden as to entirely close the **V** for a time, the gas passing through **P** cannot be put out. A small flame is thus kept burning which otherwise would have been put out. Any change in the temperature of the atmosphere, however rapid it may be, is too slow in its effect to put out the gas.

There is a certain amount of sluggishness in the apparatus to feel differences in temperature, due to the large amount of metal and water to be heated; and this inertia acts so that rapid fluctuations of pressure in the gas main are liable to put out the gas. A large quantity of heat is given to some parts of the incubator before the regulator feels it. But when it does feel it, the gas is put out in the effort to maintain equilibrium. Owing to this sluggishness, it is important that the gas should be delivered at nearly constant pressure.

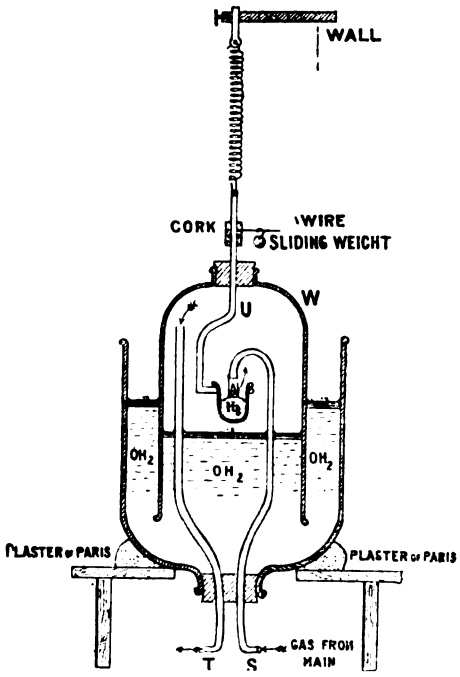

Fig. 4.

A pressure regulator, or apparatus for getting rid of these fluctuations, is shown in *fig 4*. On the spiral spring hangs a wire **U** carrying the inverted glass vessel **W**, which dips into a vessel of water covered with a film of machine oil to prevent evaporation. The wire **U** carries also a little vessel of mercury, into which dips the platinum **V** tube carried by the glass tube **S**. This tube forms the inlet. The tube **T**, which is the outlet, is connected with the tube **Q** of the temperature regulator. When the fluctuating gas enters **S** it moves the vessel **W** up or down, according as the pressure is greater or less than the mean. The effect is obvious on referring to the figure. Increased pressure means increased throttling, and *vice versa*. The gas, therefore, leaves the tube **T** at constant pressure, and is ready to supply the temperature regulator. With these regulators the temperature of the incubator could be maintained constant for weeks together, without fluctuating more than a sixth of a degree Centigrade from the desired temperature.

Another apparatus the President described was a water distiller, designed by himself and Mr. Clark conjointly. A section of this apparatus is seen in *fig. 5*. This apparatus has been supplying the physical laboratory with distilled water for the last seven years, and requires no attention whatever.

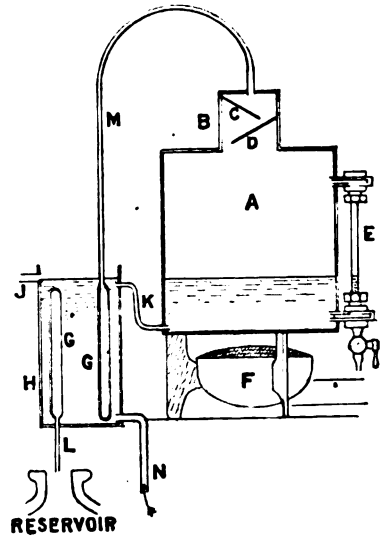

Fig. 5.

The large vessel **A** is the boiler, with a Fletcher burner underneath. On the top is a box containing inclined plates to prevent spray entering the condenser pipe **M**. **H** is the condenser, consisting of a thin cylindrical shell, the section of which is **G G**; this shell is the cooling surface, and takes the place of the ordinary worm; as indeed is now customary. The water to be distilled and that which is used for cooling enters at **N**. The water fills the condenser to the level of **J**, the overflow, which is kept constantly trickling into a waste-pipe while the apparatus is in action. The same water also through **K** fills the boiler to the same level. The latter, therefore, is kept at a constant level, a very important acquisition; also, the hot water of the condenser rises to the surface, and it is this hot water which feeds the boiler. There is, therefore, some economy of heat. **E** is a gauge-glass, to enable one to see the water level if necessary. Through the delivery tube **L** the condensed water is carried to the reservoir.

The whole apparatus is made of copper. The boiler has a metal jacket surrounding it, to economize heat; the jacket is not shown in the figure. In using the apparatus the only work to be done is to put on a gentle current of water and light the gas, and lastly, not to forget the rate at which the apparatus distils.

Lightning.

By Dr. McPherson, F.R.S E.

(Lecturer on Meteorology in the University of St. Andrews.)

AWE and grandeur combine to make a violent thunderstorm the most impressive of the many wonderful phenomena in nature. Threatening clouds, in sullen darkness, envelop the sky; a blue-black air seems to weigh on the earth; almost hidden are the cold, dark mountain-peaks; the lower animals cower under the weird influence; the music of heaven is silenced; and even the leaves tremble under the

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mysterious witchery. Then, all on a sudden, from out of the murky sky a brilliant flash of vivid light issues in unspeakable glory, zigzaging its course towards the earth; and thereafter follows a loud crackling noise, that gradually weakens off into reverberating volumes of sound. The cattle rush under the trees, weak-minded people quake with fear, and all nature seems startled. Only those who are "born to rule the storm" can glory in it. Elijah of old had a spirit that chimed in with the spirit of the thunderstorm; and Byron was in rapture as flash after flash of lightning leaped from peak to peak of Switzerland's Juras.

Early electricians were struck with the resemblance of the effects of lightning to those of the electric spark produced by the discharge from an electric-machine. But Franklin was the first to prove the identity of the two phenomena. In 1749, that exemplary natural philosopher published the result of some experiments. He prepared a common kite, armed with an iron point, to which the pack-thread string of the kite was fastened. To the lower end he attached a key, and to the key a silk ribbon, in order to insulate the apparatus. Having sent up the kite, on the approach of a storm, he observed the fibres of the string beginning to bristle, and by touching the key with his finger he received a shock and observed a spark.

Dalibard followed this up by erecting a pointed insulated iron rod on the top of a house near Paris. During a thunderstorm a number of sparks were drawn from the rod; this suggested the lightning-conductor.

Most unfortunately the famous Russian electrician, Richmann, was killed by a discharge from one of Dalibard's bars; this suggested the propriety of having placed near the bar a metallic ball, which is well connected with the ground, and which is nearer the bar than the observer himself.

It has been found that the presence of electricity in the air is not confined to stormy weather; there is *always electricity in the air*. What, then, is lightning? It is the dazzling light emitted by the electric spark when it shoots from highly-charged clouds. Scientific men are not yet settled about the reason for the brilliant appearance of the lightning—white in the lower atmosphere, and violet-like in the higher, on account of the varied density. It seems to such eminent authorities as Professor Tait, Sec. R.S.E., that the sudden expansion of the air by the electric discharge makes the molecular particles in the initial line suddenly strike against a mass of air, which to it is like a rigid wall, and in this rapid and violent concussion generates a heat which becomes luminous in lightning. The zigzag direction of some flashes is ascribed to the resistance offered by the air condensed by the passage of a strong charge. The spark then diverges from a straight line, and takes the course of least opposition. This theory bears out the photographic result, which cannot be accounted for by ordinary irradiation; for, from numerous photographed specimens before us, we find that the forked lightning-flash is of finite breadth.

There are three forms of lightning—forked, sheet, and ball. The first is an electric discharge from a cloud to the earth. It strikes the highest points, and then takes that path to the ground which offers least resistance to its passage. When forked lightning passes through dry sand it fuses the sand, and produces what is known as "fulgurite." Strange, too, forked lightning may ascend; this depends on the different potential of the charges of the cloud and the earth. It is imprudent, therefore, during a thunderstorm to stand near any projecting, isolated object, as a tree; and especially under oaks and elms, which are very good conductors. Sheet-lightning may be regarded as the brush-like discharge from cloud to cloud; the flashes fill the entire horizon without any definite shape, and there is no danger resulting from it. Ball-lightning, rarely met with, consists of balls of fire visible about ten seconds, and then bursting with a loud explosion.

Lightning often covers a distance of three-quarters of a mile, but it passes in less than the ten-thousandth of a second. The thunder is the violent report which succeeds lightning in stormy weather. It is probably due to the very sudden expansion by heat of the air along which the current passes. The lightning and the thunder are simultaneous; but an interval of time is observed between them, from the fact that sound travels at the rate of 1,100 feet per second, whereas the passage of light is almost instantaneous. Near the place where the lightning strikes, the sound is dry and of short duration; but generally the thunder consists of a number of reports heard in succession, ending in a prolonged rolling sound of varying intensity. When we consider that a flash may be nearly a mile long, we have all the conditions necessary for a continued sound. Suppose one end of the flash was close to us, while the other was a mile away, we would hear the sound of the near percussion almost at once, while that from the far end would not reach our ears for five seconds; and, as the sound has to come through a medium of varying transmitting powers, its intensity will vary correspondingly.

Experience has shown that electricity travels more easily through metallic rods than through buildings. Lightning-conductors are, therefore, employed in buildings by those who have any faith in scientific results. A lightning-conductor consists of a rod and a conductor; the former being a pointed bar of iron or copper of six feet in length, the latter descending from the rod to the ground, which it penetrates till it reaches a well or a good conducting material.

Persons near whom a flash of lightning passes frequently experience a severe shock by induction. Their bodies, like the ground, are charged with the opposite to that of the cloud; but when the latter is discharged by the combination of its electricity with that of the ground the induction ceases, and the bodies reverting rapidly from the electric state to the neutral state, the concussion in question is produced—the *return shock*.

We are all familiar with the expression, "Thunder clears the air." This has a wider and more scientific meaning than was thought of when first used. The fact was experienced, but until lately no one could account for it. It has been long known to chemists that oxygen is the life-sustaining element in the air. If animals are placed in a jar of oxygen they will dance out their existence with exhilarating joy. After several animals had been breathing in a chamber of pure oxygen, Dr. B. W. Richardson collected the gas in the chamber and freed it from all but the oxygen, so that no chemical test was able to show any difference between its character and composition and those of freshly-made oxygen gas. But when he passed this purified oxygen for the second time into the chamber the animals soon became drowsy; and in repeating the experiment, by successive purifications of the exhaled air, the animals died. He concluded, then, that oxygen which has been repeatedly passed through the lungs of warm-blooded animals, however thoroughly purified from carbonic acid gas, no longer maintains life. It has became what he calls "devitalised."

But the startling discovery remains. He passed through the devitalised oxygen—that is, the oxygen which has gone through the lungs of the warm-blooded animals without being absorbed—currents of electricity from a set of brushes connected with the positive pole of a frictional machine, and the gas had its *vital energy restored*. Animals again lived in it with the customary sprightliness. He discovered that electricity restores to its vital state oxygen which has been rendered injurious to life by passing through the lungs of animals.

Before a thunderstorm everything has been so still for days that the oxygen in the air has been to some extent deprived of its life-sustaining power, and a feeling of drowsiness comes over all. We are all familiar with the strange, sleepy sensation, and half-choking feeling. But the lightning-flashes restore the lost energy to the oxygen, and a feeling of exhilaration is experienced after the storm is over. Thus, "thunder clears the air" in reality. After the passage of the lightning a highly-peculiar odour is generally produced, attributed to what is called "ozone;" and, in 1840, Schonbein showed that this ozone is a peculiar

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allotropic modification of oxygen. Then does the vitality of oxygen depend on a trace of ozone, too minute to be detected by ordinary chemical methods, absorbed by the lungs of warm-blooded animals, and reproduced by electric action? If so, the health-giving benefits of the thunderstorm will be highly appreciated by drowsy mortals.

Swift as is the velocity of lightning, it is under the control of photography. If a rapid plate and an ordinary rapid doublet with full aperture be left uncovered at night during a thunderstorm for a short time, flashes of lightning will, by development, be found in some cases to have impressed themselves upon the plate. Some of these, which we have seen, are really most wonderful in their fringed details. Man can control this marvellous visitant by the conductor and the camera; he can also be grateful to it, not only for breaking the rain clouds which will cheer the thirsty soil, but for purifying the air and lengthening animal existence.

Notes on the Salt Districts of North America.

By Thomas Ward, J.P., F.G.S.

Part II.

LEAVING Niagara I passed over a flat portion of Canada and entered Michigan, the largest salt-producing state in the Union at the moment, and proceeded by rail to St. Clair. The St. Clair district is a very interesting one. The river forms a connecting link between lake Huron and lake St. Clair, being the highway for all the trade from lakes Huron, Michigan and Superior, and the great lumber districts of the north-west. It presents a busy sight, and some idea of the magnitude of the trade in lumber, *i.e.*, sawn timber (deals, planks and boards), may be arrived at by watching the splendid vessels continually passing down to the large cities on lake Erie, as well as to other places.

The St. Clair salt district stretches for nearly twenty miles alongside the river, from the head of the St. Clair lake to north of St. Clair city. It is only within the last few years that rock salt has been discovered here. It lies at a depth of from 1,600 to 1,800 feet, and boreholes are put down as in western New York, and the pure water of the St. Clair river is used. The wells are forced, as at Warsaw. Most of the works were shut down. There had been a salt-works "boom" and far more works had been erected than the demand for salt required. Most of the salt made was sent to Chicago at a low freight, in vessels going there for western produce. At present there is no railway, though one is projected.

The most southerly works belonged to the Walton Salt Association, and were very complete. Being in full work I had a good opportunity of seeing a typical set of American salt works. The well was 1,700 feet deep, and was forced. There were seven grainers 150 feet long by 10 feet wide, also two settlers, in which the brine was heated by exhaust steam before being turned into the grainers. The settlers, made of wood, were 150 feet long, by 10 wide, and 8 deep. The steam for heating the brine in the grainers was made in two enormous steel boilers, the largest I saw at any works. The type of boiler used in America is different to the ordinary English boiler. The salt when made was placed in bins of limited extent. The American salt storehouses are very different to the English. They are made entirely of wood, and divided into a large number of compartments or bins; this arises from a law in Michigan requiring all salt to drain for at least fourteen days before it is filled into barrels or bags. This is a very good law. A bin is filled and left to drain, then another filled, and so on. As soon as the salt is ready for market the barrels are brought to the front of the bin, in an alley or gangway, and filled. Each barrel contains 280 lbs., and seven make an American ton, but eight an English. They contain five bushels of salt. In Michigan there is a State inspector, who examines every barrel before it is headed, and, if satisfactory, brands it. The barrels are often filled before orders come for them, and are stored under sheds. At these works there were extensive quays on the St. Clair river, and large wooden sheds with a storage capacity of 25,000 barrels. In Chicago I visited a storehouse where the barrels of salt are landed from the vessels, and kept till sent off by rail into the interior. The building was over 1,200 feet in length by 200 in width, and contained, on my visit, 160,000 barrels of salt, or 20,000 tons. There was capacity for a total of 186,000 barrels.

There were salt works at Algonac, Marine City, and St. Clair, all alongside the river, with quays at which large vessels could take in their cargoes, and deliver fuel for use at the works. In this district coal from Ohio was used. At one of the small works, in boring for salt a natural gas was met with, which I saw ignited. It was not in sufficient quantity to make it worth while utilising for salt making. The depth of the boring to the gas was only 150 feet. At the works of Thomson Brothers, St. Clair city, petroleum was used as fuel under iron pans. It was blown under the pans by high-pressure steam in the form of fine spray, and when ignited made a very fierce fire, the flames extending 20 or 30 feet under the pans. There did not appear to be much saving by this process, and I only saw two sets of works in America using "oil." A proposition was being discussed in western New York to supply, by means of a pipe-line, all the works in the Warsaw district with petroleum from Pennsylvania or Ohio. At the Diamond Crystal works at St. Clair one large circular pan, having an area of 1,200 square feet, was used. The salt falling to the bottom was raked into a pocket at the side by means of mechanical rakers. Pans similar to this are in use in England, but are covered over, and the steam evaporated conveyed beneath other pans to make coarse-grained fishery salt. The brine of this district, notwithstanding the purity of the water of the St. Clair river, contains a good deal of lime; and very ingenious plans were adopted to get rid of it. All the salt made at the Diamond Crystal works was put up into small calico bags, and these packed into barrels and then distributed over the States for domestic and dairy purposes.

From the St. Clair district I proceeded via Port Huron to East Saginaw and the Saginaw River district, and the Tawas district, some 70 miles further north. This was the great lumber district of Michigan.

The great interest to me of the lumber district was that here salt was made more cheaply than in any other part of America. The manufacture has increased with marvellous rapidity.

There were made in	1861.....	125,000	barrels of salt.	
,,	,, 1871.....	728,175	,,	,,
,,	,, 1881.....	2,750,299	,,	,,
,,	,, 1887.....	3,426,194	,,	,,

Thus in 26 years the make had increased from a little over 15,000 tons of salt per year to nearly 430,000 tons. The reason for this rapid growth is very simple. The lumber mills—where all the pine wood is cut up into the deals and boards with which we are all so familiar—require a large quantity of steam to work the saws and machinery. As soon as it was known that brine was present over nearly the whole lumber districts, the idea of using the exhaust steam for making salt at once occurred, and every lumber mill soon had attached to it a salt works. By this means one of the best illustrations of the utilisation of waste products that it can be possible to have was provided. The exhaust steam was passed through pipes at the bottom of grainers, or large wooden pans, and the salt thus made. The sawdust and slabs from the wood were used to generate the steam, and waste pieces of wood were cut up into barrel staves and heads. The lumber trade and salt trade thus assisted each other, and salt was made at a merely nominal price. Hence the cheapness at which it could be marketed, and consequently the great sale of it. Nothing that I saw in America gave me a greater impression of the activity of the Americans than the lumber mills, a number of which I inspected.

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Close to Tawas, in the heart of the woods, I visited a small set of salt works and a brine pumping station. Here was pumped the brine that was sent through pipes to Au Sable and Oscoda some 13 miles off to the north. In 1888 brine to make 215,000 barrels of salt had been thus sent on to Oscoda. The depth of the well at Tawas was only about 850 feet.

The contrast with our English salt works was very great. At home all vegetation is destroyed by the smoke. Here was tree life in full vigour on every hand without any sign of destruction.

The general depth of the brine in the Michigan lumber districts is about 1,000 feet. It contains a good deal of lime, and has to be allowed to settle. There is not so much of the finer dairy salts and salts for domestic consumption made here, owing to its being necessary to wash the salt in a solution of saturated brine with soda, to take away the objectionable chlorides of calcium and magnesium which prevent American salts being used where meat or butter is required to be kept for any length of time. The chief trade from the Saginaw district is with Chicago and Milwaukie for distribution out west. The salt is all packed in barrels. The small calico bags, containing from 3lbs. to 12lbs., are all carefully packed in barrels. The barrel is, in fact, used everywhere for salt, and a cooperage is a necessary append ge to all salt works.

The Michigan Salt Association, which is formed of nearly all the salt makers in Michigan, is one of the most powerful factors in the salt trade of America. By its action the price of salt has been kept very low all over the States, and any new salt district struggling to make its way in the world feels very severely the competition of this powerful association.

The salt formation of Michigan is described as lying at "the base of the coal formation."

The Canadian salt formation is in the province of Ontario, immediately to the east of the St. Clair river and Lake Huron. When on the banks of the St. Clair it is easy to see Courtwright, the most southerly of the Canadian salt works, with a well about 1,700 feet deep, similar to those at St. Clair and Marine City. Kincardine and Goderich lie in similar positions on the eastern shores of Lake Huron to Oscoda and Tawas on the western shores. It was whilst a boring was being made for petroleum, in 1866, that rock salt and brine were found at Goderich. At a later period Mr. Attrill made some experimental borings. The following will give a good idea of the formation in which the salt occurs:—

	FT.	IN
Clay, gravel, and boulders	78	9
Dolomite, with thin limestone layers	278	3
Limestone, with corals, cherts, and dolomite	276	0
Dolomite, with seams of gypsum	243	0
Variegated Marls, with beds of dolomite	121	0
Rock Salt	30	11

Below this were found five more beds of rock salt, with dolomite and marls intervening. After these were penetrated it was found that the saliferous formation rested conformably on the magnesian limestone of the Niagara formation, and, consequently, belonged to the Upper Silurian Age.

I visited the salt works at Goderich, Clinton, and Seaforth. The works are not very large, and a number were shut down. Iron pans are used at nearly all of them, and wood and coal used for fuel. The wells are from 900 to 1,700 feet deep. No new processes were being carried out in Canada, and there seemed less enterprise than in the States.

Kansas City, on the Missouri river, is a very go-ahead place, with a population of over 160,000 inhabitants. It is a city of the present generation. Hutchinson, where I found the Kansas salt works, is about 235 miles to the south of west of Kansas City. About 12 years ago the site was prairie land, and 15 years ago the buffalo pastured where now is the main street. Rock salt was not discovered till 1887, yet in 1889 no less than 90,000 tons of salt were made in Kansas State. There had been a salt "boom" on when I was at Hutchinson, and some 10 or 12 sets of salt works had been erected in the most modern style. Contrary to my experience elsewhere, these were pan works, that is, pans after the English style were being used. It would seem as if American experience was tending towards the open iron pan with direct heat, especially when coal is used. Some of the pans were as large as the largest in use in England. At the Western Salt Works I found four pans each 115 feet long by 24 feet wide, but only eight inches deep. Fully one half of the works were shut down, and some of them had never been used at all. There was a similar state of things to that in the St. Clair district. Speculators had set up works far in excess of the trade demands, and the Michigan Association "dumped" its salt in the markets at such a low price that the newcomers could not compete. The wells at Hutchinson (or bore holes) are not so deep as most of those in other districts. The rock salt lies at Hutchinson at a depth of 450 feet. At Kingman, where a rock salt mine has just been started, the depth is 665 feet. At Ellsworth, where it was first discovered in 1887, it lay at the depth of 730 feet. The bed of salt is very thick and comparatively pure. It seems more like English rock salt, and, being in the Triassic formation as in England, the brine is freer from objectionable ingredients than most American brines. The bed of salt varies from 140 to 250 feet or even more in thickness. There is no natural brine but the water of the Arkansas river—or, rather, what is locally termed the "underflow of the Arkansas," which is plentifully met with about 27 feet from the surface—is pumped, and the wells are forced as before described. As the rock salt lies comparatively near the surface, and as subsidence of the overlying earths may be expected after brine pumping has gone on for some time, the Hutchinson salt manufacturers prefer to carry their bore-hole well into the salt, and then force the water down the interior tube so as to begin the waste of the salt at the bottom rather than on the surface of the salt. By doing this, they postpone the day of serious subsidence. I did not visit the other small isolated salt works in Kansas; but I am informed that new works are being built, salt having been discovered over an area of country nearly 100 miles square. The growth of the salt manufacture in America has been almost unprecedented, and new salt beds are continually being discovered.

The Ohio, Pennsylvanian and west Virginian salt districts, which are of minor importance, I was obliged to pass by, as I was compelled to set sail home again. In the space of three weeks I travelled over 4,000 miles and visited some 70 sets of salt works, and saw many different processes of salt making. Probably few, if any, Englishmen have had the same opportunities of visiting the American salt works, and the same facilities of thoroughly inspecting them. I have to thank the Americans and Canadians everywhere for the great kindness shown to me; but for which I could not have seen so much in so short a time. My visit to, and inspection of the American salt works will always remain as one of the brightest and happiest episodes of my life.

The Past History of the Moon.

By Rev. F. F. Grensted, M.A.

(Second Master of the Merchant Taylors' School, Crosby.)

THE attention of the scientific public has been largely directed of late to what may be termed the physical side of astronomy. The universal application of Newton's law of gravitation, not only to our own, but also to stellar systems of double and multiple stars, has long since proved that, dynamically speaking, the universe is a unity. Spectroscopic investigations of sun, stars, nebulæ, and comets have proved that this unity also holds good chemically; and now we are brought

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face to face with such theories as the speculations of Norman Lockyer, who holds that a universal origin of stars, nebulæ, and comets is to be found in swarms of meteorites, condensing and colliding under the influence of gravitation—where the meteorites come from being a question for further investigations. As man slowly comprehends the secrets of the universe he seems everywhere to proceed from the marvellous diversity of observed facts to universality of law, uniformity of origin, and unity of plan.

Under these circumstances it may be acceptable to the readers of *Research* that I should re-state a theory of my own, which is a small contribution to the doctrine of the uniformity of origin of the heavenly bodies, and which was first made public at a meeting of the Liverpool Geological Society in November, 1887. I seek to show that all the observed differences between the condition of the earth and that of the moon may be deduced as simple consequences of their difference in size; and that they, therefore, take their places in the universe as two bodies to whom this unity of plan applies. Now the great distinction between the moon and the earth is that the moon is utterly without air or water, and that whereas the surface formation of the earth is almost entirely shaped by the action of water, that of the moon seems to be entirely the result of violent volcanic action. There are neither river valleys nor coast-line cliffs—nothing but uniform bare plains alternating with regions covered with extraordinary ring mountains, or ramparts, which are often 10,000 to 15,000 feet high, surrounding level plains 40 to 50 miles across, only interrupted by a peak or two rising quite abruptly some 2,000 feet or 3,000 feet.

To account for this profound diversity let us assume that earth and moon had the same origin, such as would be the case if they are the final product of a condensed swarm of meteorites. Certainly, if those meteorites resembled the ones that now fall on the earth, it is clear that the surface composition of this planet cannot represent the composition of its interior; for, whereas meteorites are usually very largely composed of pure unoxidised iron, the surface of the earth is to such an extent composed of oxides and their combinations that over 40% by weight is oxygen; it is, in fact, nearly as much oxidised as the elements of which it is composed will admit.

There are arguments which tend to shew that this oxidation can be only superficial. The average density of rock is about 2¾ times that of water, that of the earth as a whole 5½ times; and this is greater than would be the case if it were composed of any known compounds of oxygen, unless it be that the enormous superincumbent weight is sufficient to compress the interior enough to raise the specific gravity to the required amount. This, however, is very unlikely; were it so there would surely be some connection between the sizes and the specific gravities of the different planets, the larger being apparently made of the heavier material, whereas the exact opposite is the case—the larger are made of lighter materials.

It it thus probable that the interiors of both earth and moon are composed of heavier materials than the outer crust, probably unoxidised metals such as iron, which is so commonly found in meteorites.

It is reasonable to suppose that both earth and moon once glowed with an intense heat, of which the extinct volcanoes on the moon are a record, and that the residues of this heat in the case of the earth still give rise to those volcanic phenomena which show that we are merely living on a cooled crust over an intensely-heated interior. If this be so, we may assume that all the heavier materials would have condensed at the centre, at an epoch when the temperature was so high that chemical action between them and oxygen could not take place. As the temperature fell combination would ensue, and so layers of compounds which would be of lighter specific gravity would form around the heavy metallic nucleus.

Probably a zone of sulphurization would precede the final one of oxidation, and thus we find volcanoes, which derive their products from great depths, as evidenced by the great heat, always evolve sulphur and its compounds. We ourselves live on the outside oxidised crust which surrounds the unoxidised nucleus, just as the slag, made up of oxides, which floats on the molten iron in an iron furnace.

We can, though only roughly, apply mathematical calculation to these suppositions.

If the nucleus be of iron its density will be 7¾. The crust, being of rock, will have a density of about 2½, which is that of ordinary stone, and the density of the earth as a whole is 5½. Then, taking the earth's semi-diameter as 4,000 miles, the crust would be 681 miles thick. Making the same suppositions for the moon, whose density is 3½, we shall find that the crust will be 478 miles thick, the moon's semi-diameter being about 1,000 miles. Now, since the moon's diameter is about ¼ that of the earth, the crust should be in the same proportion also; that is, about 170 miles, instead of as we find it, 478 miles. Whence this difference?

It is only what we might have expected. The moon. because the diameter is ¼ that of the earth, has about 1/16 the surface to only 1/64 the volume. It is this four times greater proportional surface of the moon that must have given the greater opportunity for chemical combination, and so used up the extra oxygen, which in the case of the earth goes to form air and water to make the greater proportional amount of oxidised crust. This, of necessity, left the moon airless and waterless.

Further: we should remember that the amount of air and water is very trifling compared with the the total mass of the earth. A simple calculation brings this very forcibly home to our minds.

We assume that our air and water is only prevented from absorption into the unoxidised nucleus by the protecting oxidised crust which intervenes. Suppose this protection were removed, what thickness of oxidation—that is, how thick a fresh crust—could our existing air and water produce on an iron nucleus? Let us assume all the water on the earth to be equivalent to a uniform ocean two miles deep. The oxygen of the atmosphere would only suffice for less than half a yard of thickness, and the oxygen of the water, which comprises eight-ninths of it, would only be able to use up less than 1,000 yards, so that an additional thickness of less than a mile to a crust, which our calculation supposes to be some hundreds of miles thick, would remove the oxygen of both air and water from the surface of the earth, and there would be still in the huge remaining uncombined metallic nucleus plenty of possibilities for the hydrogen and nitrogen. Hydrogen, for example, we know is capable of forming a sort of pseudo-alloy with metals, such as platinum and iron, and we know it is evolved in large quantities during volcanic eruptions. Moreover, hydrogen has been found in meteoric iron in this condition.

Many other differences besides the one I have laid stress upon will result from the simple fact that the moon is smaller than the earth. The shape of a mountain is to a certain extent a compromise between cohesion, which tends to hold it together, and gravity, which strives to flatten it out. On the moon, gravity is about 1/6th what it is on the earth—cohesion the same. Again, as Mr. Mellard Reade has pointed out, because the melting point of rock is raised by pressure the interior of the earth may be solid, while the moon with less pressure may have been liquid, and the surface configuration of the two bodies would be profoundly different in consequence.

However, enough has been said to show how far-reaching are the consequences of a simple difference of size in two heavenly bodies. The larger they are the greater, as they cool, must be the atmospheric and aqueous covering. Smaller bodies, such as Jupiter's moons, must be airless and waterless; intermediate bodies, such as the Earth, Mars, and Venus, will be in the condition in which we find them. And so will all these bodies give evidence in favour of the great doctrine of the physical unity of the universe.

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Notes in Brief.

An important discovery of black granite has been made on the Brumsberg estate in Sweden. This fine stone has of late been superseding the green granite of Varberg for architectural purposes in Sweden and elsewhere.

"Turfa" is the name given to a mineral which has been discovered in quantity at Maratin, a place about sixty miles south of Bahia, in Brazil. It contains petroleum, paraffin, gasoline, and lubricating oils.

A new compound of phosphorus ($P_4 O_6$) has been discovered by Professor T. E. Thorpe, which takes the form of acicular crystals, melts with the warmth of the hand, and glows under the same conditions as phosphorus. It burns readily in oxygen and chlorine, and forms a new compound with ethyl alcohol.

The grand cañon of the Colorado, one of the natural wonders of the North American Continent, is being surveyed for a railway. The cañon varies in width from 300 feet to several miles, and is bounded by walls of rock in some places almost vertical, and of enormous height.

It is proposed to construct an electrical railway from the Falls of Niagara to Queenstown, on the Niagara River, five miles north of the Falls. Twenty-five thousand dollars are required to build the railway. The proposal of an English syndicate to lease the water power of the Falls for an electrical factory has been accepted.

Mr. Arthur Robottom, well known in Liverpool, Birmingham, and London, &c., as a pioneer of commerce and introducer of new trade products, has left Liverpool by the *John Elder* for Brazil, Chili, and Peru on a voyage of discovery. One of his principal objects is to inspect a mountain in the Andes that is reported to contain a variety of chemicals naturally formed, and also borate of lime and nitrate of soda deposits. Mr. Robottom was one of the first to sell nitrate of soda for the manufacture of nitric acid. He was engaged in the manufacture of paraffin oil, and was instrumental in the introduction of corozo nut or vegetable ivory for button making. He also introduced to the trade piassava from Brazil, the keltol from Ceylon, and a variety of other articles that now find employment for thousands of people who are engaged in working them up.

From time immemorial stories have been rife in which snakes and other reptiles have been credited with the possession of a precious jewel. One species of hooded cobra in Ceylon has long been regarded with special fear and veneration by the natives, in consequence of its being said to possess a luminous stone which it carries in its mouth, and occasionally drops on the ground, when the body of the cobra is swayed to and fro before the stone, as if fascinated by its light. The existence of the Naja-Kallu, or "cobra-stone," has been confirmed by Professor Hensoldt, who, in a recent article in *Harper's Magazine*, attempts to solve the mystery. The stone is found to be a rounded pebble of chlorophane, which, when warmed, emits a greenish phosphorescent light resembling that produced by the female *lampyris* or fire-fly. Lying in the dry river gravel, the cobra would be attracted by the "glow" of the pebble, and would soon notice that fire-flies (which form part of its food) were more easily captured in the vicinity of the shining stone. In course of time success in capturing food would depend upon possession of this stone, which the cobra would seize in its mouth to prevent another snake from securing it. This practice would eventually become an inherited instinct among the cobras of Ceylon.

The Royal Botanic Gardens at Peradeniya are likely to become a resort of professing botanists who wish to study tropical flora in their native haunts. The British Association has undertaken to establish a permanent laboratory in the centre of the gardens, beside the official bungalow of the director, Mr. Trimen.

Mr. D. Morris, the assistant-director at Kew has discovered that the sugar-cane produces a number of seeds, from which it is possible to grow a variety of improved canes; and it is anticipated that by cross fertilization and selection of the best seeds a considerable increase will be made in the yield of sugar in the tropical plantations.

Among new American inventions is a photographic camera, which has been devised by Mr. George S. Moler, Ithaca, N.Y., especially designed for instantaneous work, in which provision is made for storing and manipulating for exposure a series of dry plates, whereby a succession of photographs may be taken with great rapidity, and the plates used in irregular order, if desired.

A novel operation has been performed in the Edinburgh Royal Infirmary. A farmer was suffering from a diseased leg bone, induced by an accident. On medical advice he came to the infirmary and was put under the care of Mr. Miller, surgeon, who determined to remove the diseased portion and substitute an ox rib. This operation, according to a contemporary, was duly performed, and it seems it has been so successful that the man will be about again shortly with a limb as strong and healthy as ever.

The rapid growth of the medical school of Owens College, and the urgent demand of one of the chief branches of medical study, have for some time rendered the council of the college desirous of providing the professorship of pathology with an endowment such as would allow its future occupants to devote themselves altogether to the duties of the chair. To the great satisfaction of the council the residuary legatees of the late Mr. Daniel Procter have announced their willingness to contribute £60,000 for the pathological professorship, which will henceforth be associated with the name of Mr. Procter.

Conferences have been lately held by the Animals Institute on the subject of horse shoeing, and an understanding has been arrived at as to the best kind of shoe to adopt. The pattern selected is a simple, light, and nailed shoe. It it perfectly level on the upper surface where attached to the foot, and very narrow, almost like the Charlier shoe. It is a custom with many horse owners to cut out a certain portion of the bottom of the foot. The Institute considers that it is better not to interfere with the feet of horses by cutting out in any way, except just to take off any protuberances so as to get the natural frog pressure, as it is found that expansion begins at the top of the foot and extends downwards, gradually deepening until it reaches the frog surface. The members of the conferences were aided considerably by the numerous specimens of various kinds of horse shoes exhibited at the Institute, the collection including an unearthed shoe said to be 2,000 years old.

An appeal has been issued to aid Peter Lechner, the hermit of the Sonnblick, the highest meteorological station in Europe, who threatens to give up business unless his salary is increased and he is enabled to marry. The annual cost of this station is only 1,800 florins, 600 of which are contributed by the Austrian Government, and 700 by the Alpen Verein, and the deficiency by the Meteorological Society. Peter has had three years of loneliness on the Sonnblick, looking down on the world, and in communication with it by telephone, and yet

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completely cut off from it during winter, save at Christmas time. He is tired of his isolation, and wants twenty florins a month more salary, a wife, and a dog, besides some sundries, such as a pair of fur-lined boots. Of late he has been enabled to visit Vienna, where he has been *fêted* sumptuously, and he vows that not another winter will he pass at his station without a companion to share his joys and sympathize with his griefs. To enable him to marry, twenty florins a month increase of salary are necessary.

Our Portrait Gallery.

XXII.—JAMES BELL, C.B., D.Sc., PH D., F.R.S.

JAMES BELL, who was born on the 20th November, 1825, is a native of the county Armagh, but of Scotch extraction on the side of both parents. His early education was directed with a view to his entering the ministry of the Scotch Presbyterian Church, but a nomination was offered him in the Inland Revenue Department, which he accepted, and thereupon gave up the idea of entering the church. His first appointment was to Edinburgh, where during his leisure time he continued his classical studies with the assistance of a tutor; but after the lapse of some time he became connected with the Edinburgh Philosophical Society, and soon turned his attention to the study of science, his favourite subjects being chemistry and physics.

In 1849 he was selected to attend a systematic course of scientific training at University College, London, where he was a student for three years. During his college course he was eminently successful and won several prizes, including a gold medal in practical, and a silver medal in theoretical chemistry.

Towards the end of his studentship a question of some importance arose for solution as to the practicability of detecting vegetable substances mixed with coffee for the purpose of adulteration, and it was arranged that he should assist in the chemical part of the investigation, under Professor Graham, Dr. Stenhouse, and Mr. Campbell. In carrying out the investigation a large portion of the analytical and other chemical work was done by him, including the analyses of the ash of seven descriptions of coffee, three of chicory, and also that of lupins, acorns, maize, parsnips, and dandelion root respectively. The results of these analyses were afterwards published in the *Journal of the Chemical Society*, and they are usually found quoted in standard chemical works.

A question of considerable importance subsequently arose between the British and Spanish governments as to the amount of alcohol which could be generated by fermentation in a wine. The subject gave rise to considerable discussion, and, in order to solve the problem, he made a long and careful study of the grape and malt ferments; and, as the result of his experiments, he established the interesting fact that there was an essential difference between the two ferments, and that each was unsuited to the soil of the other. He found that the grape yeast was capable of generating an amount of alcohol equal to upwards of 32 per cent. of proof spirit, while the action of the malt yeast ceased when the proportion of proof spirit reached 28 per cent. in the saccharine liquid. The particulars of this investigation were published in the *Journal of the Chemical Society* in 1870.

About this time considerable interest was excited by the alleged discovery of a distinctive "sewage fungus," and he turned his attention to the subject and made a careful study of the life history of the particular fungus or mycelium development, and he identified it as a member of the confervoid algæ, viz., *oscillatoriaceæ*, and showed that the same vegetable growth could be produced by the addition of sugar to water containing a trace of phosphate. He afterwards read a paper on the subject, which was published in the *Monthly Microscopical Journal*, 1871.

As regards his scientific work, he is perhaps best known in connection with his researches into the composition of articles of food and the variations that occur in their constituents. Some of these researches have proved of considerable practical importance as well as of much scientific interest. His investigation of butter is a striking example of this twofold value and interest. When he commenced this research very little was known about the constitution of butter, or the extent of the variations that occur in its constituents. It was supposed that it was composed of the simple glycerides of the fatty acids, but from the results of his experiments he showed that its constitution was of a very complex nature, and that the radicals of the volatile and fixed acids were combined in the same molecule to form a compound etheral salt; and from the analyses of a great variety of commercial butters obtained from different parts of the kingdom he proved that the insoluble fatty acids varied to the extent of nearly 4·5 per cent, instead of about one per cent, as had been previously supposed. He further established the important fact that there was a correspondence between the proportion of fixed fatty acids and the specific gravity of the butter fat, and that it was possible to predicate within a few tenths one result from the other. In conjunction with this discovery he found that there was a considerable difference between the specific gravity of a butter fat and that of ordinary animal fats, and showed that this difference was capable of being made available as a ready and an easily applied preliminary test for the genuineness of a butter.

The particulars of this research were first published as a parliamentary paper, and the importance of the results of the investigation may be realised from the fact that, if the previously supposed limit of variations in the composition of butter had been enforced under the Sale of Food and Drugs' Act, a large proportion of the commercial butters

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DR. JAMES BELL, C.B., F.R.S.

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PROFESSOR G. HENSLOW, M.A., F.G.S.

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produced in this country would have been pronounced sophisticated. As might be imagined, at first the accuracy and soundness of his results were seriously challenged and strongly contested, but the facts were gradually admitted, and the range of variations which he indicated is now admitted to the full.

Among his other work which deserves special notice, and standing perhaps next in importance to his research on butter, is the thorough investigation which he made into the variations that occur in the composition of milk, yielded by different breeds of cows, and under the various conditions and changes of food and season. The results of this investigation clearly showed that great variations were possible in the quality of genuine milk, and, guided by the experience thus obtained, he has always been opposed to the adoption of too high and rigid a standard which might lead to the infliction of injustice upon milk vendors. His researches have all been characterised by thoroughness, and his investigations have almost invariably been fruitful in the way of bringing to light some new facts of more or less scientific interest. His research on tea comprised nearly four hundred and fifty results and estimations, and he ascertained for the first time that the pectin bodies formed a constituent of the tea leaf, and that there was no substance present, as had been previously supposed, deserving the name of gum. In his proximate analysis of coffee he separated and estimated for the first time the sugar, dextrin, and caffeic acid, and he has shown that the saccharine body present is peculiar to coffee, and bears the same relation to cane sugar as melozitose. In the case of cocoa he supplied an urgent want by furnishing a complete analysis of the ash of each description of commercial cocoa, and he resolved cocoa into a larger number of proximate constituents than had been previously done by any chemist. He also established the fact that the cocoa red is not a natural constituent of the cocoa berry, but that it is a product of the oxidation of the astringent principle or tannin natural to cocoa, and he further determined for the first time the proportion of the theine-like body present in the cocoa berry. In his research on cereals he observed that the soluble albumenoids of the respective cereals possessed varying degrees of activity or converting power according to the grain from which they are derived, the active principle of rye being found to possess the highest converting power on starch, while that of rice exercised the weakest action. As the result of this observation he pointed out that in the proximate analysis of cereals this action of the albumenoids had apparently been overlooked, and that by using water for extracting the sugar a considerable quantity was produced in the operation beyond what was naturally present, and to this extent the result of the analysis would be vitiated.

He has carefully elaborated the whole of his original researches on foods, and made them the groundwork for a handbook, entitled *The Chemistry of Foods*. The book, which was prepared as a hand-book for the South Kensington Museum, is published at a price which barely covers the cost of publication, the object being to bring a chemical treatise on foods, containing descriptions of methods of analyses and directions for detecting adulterations, within the reach of the general public. This book has been translated into German and published at Berlin, at the instance of Professor Sells, Chief Medical Officer of Health.

One difficult problem solved by Dr. Bell about the year 1886 is worth mentioning, in connection with what had hitherto been difficult in distinguishing between horse flesh and beef. He solved this difficulty by investigating the fats, and soon found such essential differences between the respective fats as to afford a positive means of distinguishing between horse flesh and beef by tests easy and convenient of application.

A review of Dr. Bell's scientific work would not be complete without a reference to his exhaustive and interesting research on tobacco, both in the commercial and green condition. The research, which was a long and laborious one, exhibits, among other features, a marvellous example of plant analysis, both organic and inorganic. Some idea of the magnitude of the undertaking may be formed from the fact that the tobacco was resolved into seventeen proximate constituents, and that twenty descriptions were submitted to analysis.

A point of great interest, as the outcome of Dr. Bell's study of the development of the saccharine matter in the green leaf of the tobacco plant, is the mode of transformation of the starch into three sugar principles, corresponding to saccharose, dextrose, and lævulose. The starch, as he explains, is first transformed by an unorganised ferment of a diastatic character by hydration into saccharose, which, by further hydration by a principle of the inverting class of ferments, becomes converted into a mixture of dextrose and lævulose.

In addition to his scientific labours he has compiled two departmental books, partly educational and partly legal and technical.

Dr. Bell was appointed Deputy Principal of the Somerset House Laboratory in 1867, and he was promoted to Principal in 1875. He has held under the Board of Trade, the appointment of Inspector of Lime and Lemon Juice for the supply of the Merchant Navy since 1868. From time to time he has rendered valuable services to various Government departments, and, from his position as Principal of the Laboratory, acts as Chemist to the Indian Government, the Admiralty, Post Office, Stationery Office, Home Office Prison Department, War Office Clothing Department, &c. He has occupied the important and difficult position of Principal Chemical Referee under the Sale of Food and Drugs' Acts since 1875, and it must be admitted that he has discharged the responsible duties of

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the office with great care, discretion, judgment, and fairness.

Dr. BELL was elected a Fellow of the Royal Society in 1884, President of the Institute of Chemistry in 1888, and created a Companion of the Bath in 1889. The degree of Doctor of Science was conferred upon him in 1886 by the Senate of the Royal University of Dublin. He obtained the degree of Doctor of Philosophy under the ordinary statutes of the University of Erlangen.

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XXIII.—PROFESSOR G. HENSLOW, M.A., F.G.S.

THE REV. PROFESSOR GEORGE HENSLOW, M.A., F.L.S., F.G.S., F.R.H.S., &c., is the younger son of the late Rev. J. S. Henslow, M.A., F.L.S., Professor of Botany in the University of Cambridge, and brother-in-law to Sir J. D. Hooker, late Director of the Royal Gardens, Kew. He was born at Cambridge in 1835, and was educated first under the Rev. E. Daniel, of Sawston, Cambs, then, from 1847 to 1854, at King Edward VI.'s Grammar School, Bury St. Edmunds, under the Rev. J. D. Donaldson, D.D., of great reputation as a Greek scholar. On leaving school in 1854 he entered Christ's College, Cambridge, of which he was a scholar and medallist, and in 1858-9 he took Honours in Three Triposes, Mathematics, Divinity, and Natural Sciences, being recorded as "Distinguished in Botany, Geology, and Mineralogy." He graduated as B.A. in 1859, and subsequently as M.A. Whilst a resident B.A. at Christ's College Mr. HENSLOW gave his first courses of lectures on botany.

In 1854 he spent several weeks in Jersey and studied the flora, contributing his first botanical paper to the *Phytologist* on the characteristic plants of the Channel Islands. In the following year he went for a botanical tour under the auspices of Dr. (now Sir) J. D. Hooker through Switzerland, during which he collected a large series of plants. In 1861 he was elected head master of the Endowed Grammar School of Hampton Lucy, Warwickshire, founded in the reign of Charles II., where botany was made a regular subject in the school. Removing to London in 1865, Mr. HENSLOW took an old-established grammar school. He was also elected lecturer on botany to St. Bartholomew's Medical School, a post he has held to the present time. Another appointment which he held was that of afternoon lecturer at the Royal Institution. For several years during his residence in London he was a popular lecturer on botany at the Birkbeck School of Science and Art, giving also many courses of lectures on botany, geology, physiography, and elementary astronomy in schools and colleges in and around London. Mr. HENSLOW still holds the professorship of botany at Queen's College, Harley Street. His experience as lecturer at the provincial philosophical and scientific institutions is very large, and few men have been more widely esteemed.

He was President of the West London Scientific Association, and has been that of the Ealing Microscopical and Natural History Society since 1881.

He has been Secretary to the Scientific Committee of the Royal Horticultural Society since 1879, as well as for several years Demonstrator on Botany at the fortnightly meetings, and Editor of the Society's journal.

Besides his extensive labours in the field of education, the contributions which Professor HENSLOW has made to botanical literature are of the highest importance. The *Transactions* of the principal learned societies bear witness to his assiduity in many original investigations, among which may be specially mentioned his papers on *Phyllotaxis*, and his experimental researches on the transpiration and assimilation of plants, as well as those on their power of absorption. For these researches he received a grant of £100 from the Royal Society.

As a writer on educational subjects to the leading magazines of the day, and by his numerous published works and articles on botany, Professor HENSLOW has made his name widely known. The titles of his published writings would alone fill a large list. Space will only allow us to mention some of the principal works and manuals of which Professor HENSLOW is the author. He wrote the volume on *The Origin of Floral Structures through Insects and Other Agencies*, one of the International Scientific Series, and is also the author of the following works, published by E. Stanford, viz:—*Lessons on Wild Flowers*, *Botany for Beginners*, and *Floral Dissections*. These form introductions to the study of botany which have rarely been equalled in excellence of design and treatment. Several of the principal articles on botany in the *Encyclopædia Britannica* are from his prolific pen. He was also the Actorian Prize essayist in 1872, the subject being "The Theory of Evolution of Living Things," published as *Evolution and Religion*.

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Museum Notes.

THE museum in the Schloss (*Inglicé* Castle), Nuremberg, is announced to be sold by public auction at Cologne. It contains one of the finest collections of old German metalwork, including examples of great artistic excellency, as well as numerous historical and archæological objects.

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A PROVISIONAL patent has been applied for with respect to an improved form of the well-known Cotgreave Indicator, now extensively used in free libraries, museums, and other institutions. The inventor, Mr. Bonnor, of the Ealing Free Library, had long recognised the trouble and loss of time caused through the manipulation of the many-coloured "slides" used to signify the various weeks that books were in a borrower's possession, and after some trouble he has produced a system whereby those articles are dispensed with entirely. It consists simply of pentagonal blocks, arranged in columns as in the present form of the indicator, each of the five slides being differently coloured, blue indicating to the public

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that the book bearing the number on the block is in the library, whilst the other colours inform the librarian how long a certain work has been in the possession of its holder. As the cost of procuring and working the new system is about 20 per cent. less than that with respect to the Cotgreave process, it posseses a favourable recommendation to free library committees, whilst librarians will find it conducive to a great saving of time, owing to there being no slides to handle.

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A GREAT deal of interest is felt, and some gossip indulged in, concerning the opening to the public of the Bowes Museum at Barnard Castle. *Apropos* of this matter, Mr. E. Y. Western, the sole acting executor under the will of the Mr. John Bowes, says :—

The late Mr. Bowes and his first wife, the Countess of Mantalbo, when they formed the idea of founding a museum, did not originally propose to locate it at Barnard Castle, their first idea being to place it at Calais, which was abandoned from a consideration of the unsettled state of politics in France. They were several years maturing their plans, and it was not until about 1872 that the building of the museum really commenced. By the will of the Countess of Montalbo, who died on the 9th of Feb., 1874, the museum was founded and given to the inhabitants of Barnard Castle and the world. What she and her husband spent upon it can never be known, as imperfect records only exist of the details of their purchases of the works of art which are now in the museum. Mr. Bowes died on the 9th of Oct., 1885, and bequeathed legacies to the amount of £135,000 to the museum. But of course debts had to be paid before the legacies, and the legacies to the museum therefore were of second rank only. Immediately after Mr. Bowes' death the surviving trustees of the Bowes Museum found themselves in possession of an incomplete building, with contents of an enormous value, and without any funds. They, therefore, in May, 1887, applied to the Charity Commissioners for help under the statutory powers, showing that the only feasible plan for providing the money needed for the interim maintenance of the museum was to borrow on mortgage of the land and buildings. The Commissioners ultimately assented to this view, and granted to the trustees the scheme dated 8th November, 1889.

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AT a recent meeting of the Ealing Natural History Society, the Rev. Percy Myles delivered an address on the advantages to be derived from visits to the South Kensington Natural History Museum, in the pursuit of a competent knowledge of natural history subjects. He said that :—

The Natural History Department of the British Museum might be regarded as *the* natural history museum of the world, and referred to those persons who went to the museum, and without previous preparation endeavoured to satisfy themselves on certain scientific topics, and possibly to impart their erroneous ideas to others. One of the reasons why the museum was the best of its kind in the world was that it had at its head a man who for the last 20 years had devoted himself to the consideration of what a museum in its arrangements and facilities for affording information should be, and who now had an opportunity of putting his ideas on that head into practice, and the other members of the staff vied with Professor Flower in their anxiety to make the treasures of the Museum accessible to all students. The botanical student would find collections illustrating admirably all the various organs of plant structure. The systematic classificatory portion had been entirely changed, and greatly improved, in the methods of communicating desired information. In it would be found actual types of each of the orders of plants, and by means of diagrams the geographical distribution and geological history of the plants were displayed. In this portion the student would discover that the basis of study he had laid out for himself in his earlier investigations could be carried out with wonderful ease and success. After this the student might continue his inquiries about the more lowly flowerless British plants. There were models of British fungi (constructed originally by Sowerby, and renovated by Worthington Smith) to assist him in his investigations. A person who had in this way gone into the museum for a few days, and had carefully pursued the course of botanical study he had laid down, and had so progressed from one subject to another, would by this time have acquired some special taste for some particular kind of flower or plant—some special order or genus—and then he could betake himself, in search of special information on his chosen subject, to the herbarium proper. The library in the South Kensington Museum was the best botanical library in the world, and its present excellence was the result of growth of only ten years. The Zoological Department contained a collection of all the beasts and birds which inhabited the British Isles. He pointed out the many entertaining and valuable lessons which could be drawn from a study and inspection of these specimens, and drew attention to the care which had been exercised in making the represented surroundings of the birds shown—the grass, rocks, &c.—of the utmost fidelity, even in the most minute particulars, to the places which the birds frequented in their natural habits. He also referred to a most helpful collection of British butterflies and moths, with their larvæ, on most accurate models of the actual plants frequented by the respective insects.

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Tests of Divisibility.

IT is commonly asserted that no easy test exists for divisibility by seven or other primes. This is incorrect : for, besides the general test given in a previous number of your valuable monthly, there are numerous special tests, a few of which, with your permission, I will now give :—

(1) Test 2581470369 for 7 and 13.

Now 9 − 0 + 1 − 2 = 8
6 − 7 + 8 = 7
3 − 4 + 5 = 4

And since 478 gives remainders 2 and 10, so does the given number : all we have to remember is the following order :—

Figures
1st − 4th + 7th − 10th + *etc.* = *a* say
2nd − 5th + 8th − 11th + *etc.* = *b*
3rd − 6th + 9th − 12th + *etc.* = *c*
and $cba \div p$ gives the remainder.

(2) A simpler method still is as follows :—

2 5 8 1 4 $\bar{7}$ 0 3 6 9

Rule—Begin with right-hand figure, miss one, subtract next two, and so on.

Thus, 9 − 3 + 5 − 7 = 4 (v. bottom line).
9 − 11 + 13 − = 11 (v. top line).

Thus, 114 = 7 *m* + 2 = 13 *m* + 10 so is the given number.

(3) For a divisor 37 proceed as in (1) but add everything, thus :

9 + 0 + 1 + 2 = 12
6 + 7 + 8 = 21
3 + 4 + 5 = 12
Now say 12 from 21 = 9.
12 from 12 = 0

Thus 90 gives the same remainder as the given number.

It should be understood that the process is an algebraical one, and those who understand algebra will have no difficulty in devising even shorter cuts.

I append a mathematical proof for 7 and 13, and the student will have no difficulty in extending the method to any prime whatever.

Let N denote the whole number; $p_0\ p_1\ p_2$.....the digits beginning with the right hand; then

$$N = p_0 + p_1 r + p_2 r^2 \ldots\ldots + p_n r^n$$
$$= p_0 - (p_2 + p_3) + (p_5 + p_6) - (p_8 + p_9) + \ldots\ldots(A)$$
$$+ r(p_1 + p_2) - (p_4 + p_5) + (p_7 + p_8) - \ldots\ldots(B)$$
$$+ p_2 (r^2 - r + 1) + p_3 (r^3 + 1) + p_4 (r^4 + r)$$
$$+ p_5 (r^5 + r - 1) + p_6 (r^6 - 1) + p_7 (r^7 - r)$$
$$+ p_8 (r^8 - r + 1) + p_9 (r^9 + 1) + p_{10} (r^{10} + r)$$

$$+ p_{3n+1}\left(r^{3n-1} - (r-1)\right) + p_{3n}\left(r^{3n} + 1\right) + p_{3n+1}\left(r^{3n+1} + r\right)$$

Therefore $\dfrac{N}{r^2 - r + 1}$ = some integer + $\dfrac{A + B}{r^2 - r + 1}$.

ROBT. W. D. CHRISTIE.

Wavertree Park College, Liverpool.

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Meteorology.

Liverpool Observatory, Bidston, Birkenhead.

The following results refer to the period between April 16th and May 15th inclusive, and are deduced from observations taken

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under the superintendence of Mr. John Hartnup, F.R.A.S, F.R. Met. Soc., Astronomer to the Mersey Docks and Harbour Board :—

(*a*) Barometer	Highest (April 20th)	30·12	Inches.
,, ,,	Lowest (May 10th)	29·37	,,
,, ,,	Mean	29·740	,,
,, ,,	,, for 23 years April	29·879	,,
,, ,,	,, ,, May	29·959	,,
Temperature	Highest (May 1st)	64·7	Deg. F.
,,	Lowest (April 24th)	37·3	,,
,,	Mean	50·5	,,
,,	,, for 23 years April	47·1	,,
,,	,, ,, May	51·8	,,
,,	,, of Evaporation	46·3	,,
,,	,, ,, for 23 years April	43·4	,,
,,	,, ,, May	47·8	,,
(*b*) Rainfall	Amount	1·361	Inches.
,,	,, Mean for 23 years April	1·650	,,
,,	,, ,, May	1·916	,,
,,	Number of Days on which Rain fell	16	
,,	Greatest fall in 24 Hours (May 9th)	0·306	Inches.
Cloud	Mean Amount (0 indicating clear sky, 10 overcast)	7·0	
,,	,, ,, for 23 years April	6·5	
,,	,, ,, May	6·2	
(*c*) Wind	Velocity, Greatest (April 23rd)	45	Miles.
,, ,,	,, Least (April 25th)	1	,,
,, ,,	,, Mean Hourly	15·3	,,
,,	Greatest Pressure on Square Foot (April 23, 9-40 a.m.)	16·0	Pounds.
,,	Direction at time of Greatest Pressure	W	

Number of Hours that the Wind blew from each of Eight Points of the Compass.								Calm Hours.
NE	E	SE	S	SW	W	NW	N	
92	161	145	56	63	120	68	15	0

NOTES.

(*a*) Reduced to 32° Fahr. and to sea level. The cistern of the barometer is 201 feet above the mean level of the sea.

(*b*) The gauge is eight inches in diameter, and is placed one foot above the ground and 189 feet above mean sea level.

(*c*) Greatest and least for the whole hour between any hour of the day and the next hour following.

Bolton.

THE WEATHER.—*April 15 to May 14, 1890.*

The strong Easterly winds which commenced on the 12th continued uninterruptedly through the third week of April, accompanied by dull, cloudy weather. The effect upon the health of the town through various forms of chest affections was phenomenal, and the death rate was abnormally high in consequence chiefly of pneumonia and bronchitis. The weekly means or totals were :—Barometer 29·77 in. ; corrected mean temperature 42·59° ; humidity 80·4% ; total rainfall 0·237 in. ; sunshine 5 hours 35 minutes ; wind Easterly. During the last nine days the atmosphere was more genial, brighter, drier, and in every way favourable to agricultural prospects. The means for the period were :—Barometer 29·769 in. ; temperature 46·44° ; humidity 69·8% ; total rainfall 0·502 in. ; sunshine 56 hours 15 minutes ; wind Northerly or Westerly.

The mean pressure for the month of April was 29·836 in., with a range of 0·992 in., and 17 oscillations. The mean temperature, 42·99°, was above the average, and the highest of the past four years ; the range of mean temperature was from 36·98° on the 12th to 52·73° on the 30th, and the extreme range of the month 33·5°. The min. in the shade fell below freezing point on four nights. The rainfall, 1·494 in., was below the average, bringing up the total accumulations for the year to 11·209 in.—about 1·5 in. more than in 1889 or 1888, and 4·4 in. more than in the dry summer of 1887. The amount of bright sunshine, 112 hours 45 minutes, is near double that of same month in 1889, and considerably above the average. The accumulations of rainfall, bright sunshine, and growing temperatures, contrasted with recent years, are decidedly higher this season, and promise well for a satisfactory return to agricultural labour and capital. The foliage of trees and the quantity of grass is fully a fortnight in advance of last season.

The month of May started gloriously warm and bright, no less than 10 hours 25 minutes sunshine being recorded. Throughout the week Easterly winds prevailed, but the high temperature and light to gentle breezes tempered its evil effects. From the 1st the barometer gradually declined, making a range of 0·46 in. The means were :—Barometer 29·756 in. ; mean temperature 51·88° ; humidity 67% ; total rainfall 0·249 in. ; sunshine 39 hours 15 minutes ; wind Easterly. During the second week the barometer was low generally throughout Western Europe, with slight range, temperature much above the average, and winds Easterly the first three days, afterwards Westerly. The means :—Barometer 29·581 in. ; temperature 49·92° ; humidity 79% ; total rainfall 0·378 in. ; sunshine 25 hours 45 minutes ; wind Easterly and Westerly.

W. W. MIDGLEY, F.R.Met.S.

Met. Observatory, Bolton, May 16, 1890.

Sheffield.

METEOROLOGICAL SUMMARY.

April, 1890.	TEMPERATURE. Highest Max.	Date.	Lowest Min.	Date.	Mean of Max. and Min.	Means for April. Daily Max.	Daily Min.	RAINFALL. Total Ins.	No. of Rainy Days.	Greatest Fall in 1 Day. Ins.	Date	Mean for Apr.* Ins.
Sheffield ...	62°	30th	31°	1st	44°	—	—	0·82	10	0·18	6th	—
Spurn Head.	57°	21st	34°	11th	44°	—	—	0·66	14	0·17	7th	—
York	61°	5th	28°	11th	44·5°	54°	38	0·65	8	0·21	12th	1·86
Liverpool ...	64°	30th	35°	11th	46°	53°	41°	1·15	15	0·26	9th	1·56
Holyhead ...	64°	30th	37°	3rd	47°	52°	42°	1·52	16	0·27	5th	1·86
Yarmouth ...	60°	22d	33°	12th	44°	49°	40°	1·03	15	0·27	8th	1·80
Oxford	64°	30th	28°	2nd	45°	55°	39°	0·98	16	0·19	21st	1·79
London	64°	30th	30°	5th	47°	57°	40°	1·89	15	0·66	25th	1·86

* The means are for 15 years.

PRESSURE.

April 16 to May 15, 1890.

On April 16th pressure was low and irregular, falling in the S. and E. and rising in the N. and W. On the 17th it was still low but rising, the rise continuing on the 18th and 19th, when readings ranged from 29·8 in. to 30·0 in. Pressure was high and very even on the 20th, the barometer reading 30·0 in. in nearly all parts of England ; but on the 21st there was a brisk fall with a depression from the N.W., and the fall continued on the 22nd, when the centre of the depression was over Scotland, with readings down to 29·2 in., increasing to 29·8 in. in the South of England. The depression had passed away on the 23rd and pressure was recovering, but it gave way irregularly on the 24th, when readings ranged from 29·4 in. in the N. to 29·6 in. in the S. On the 25th there was a depression over the South of England, and another skirting the North of Scotland, the barometer in most places not exceeding 29·3 in , and on the 26th the depressions had passed to the N.E., and pressure had quickly recovered over Britain, reaching on the 27th 30·0 in. On the 28th the barometer stood at 29·9 in. all over Great Britain and Ireland, and was only slightly lower on the 29th, and there was scarcely any change on the 30th. The barometer was high on the 1st and 2nd of May but was falling on the latter date, continuing to give way slowly on the 3rd, 4th, and 5th, when readings were between 29·5 in. and 29·8 in. On the 6th it was steadily rising again, and changed little on the 7th, 8th, and 9th, but was falling slowly on the 10th, the fall continuing on the 11th. On the 12th pressure was low, 29·4 in. to 29·5 in., with a tendency to increase, the rise continuing slowly on the 13th, 14th, and 15th, when readings ranged from 29·7 in. to 30·0 in., and there were indications of further shallow depressions from the W.

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The Weather.

During the week ending April 26th the weather was very changeable, showery, and unsettled. There was a good deal of rain with hail and snow at times, and thunderstorms occurred in some places, but there were no gales of any importance. Temperature fluctuated a good deal, but was rather below the average on the whole. There was rain on six days at Holyhead, five at Spurn, Liverpool, London, Oxford, and Yarmouth, and two at Sheffield and York. The following week, from April 27th to May 3rd, the weather was, on the whole, fine and bright, and although temperature was rather low at the beginning of the time it steadily became warmer, and from the 30th April maximum readings exceeded 60° in most places, and reached 69° at York on the 3rd. The amount of rain was slight, and it fell on three days at Holyhead, two at Liverpool and Yarmouth, one at Sheffield, Spurn, London, and Oxford, and there was no rain at York. In the week ending May 10th the weather was decidedly wet after the 5th, with frequent and heavy showers of rain in most places, and several thunderstorms occurred. Temperature was high, and maximum readings often exceeded 60°. Rain fell on seven days at Holyhead, six at Sheffield and London, five at Spurn and Oxford, four at York and Yarmouth, and one at Liverpool. During the week ending May 17th the weather varied considerably in different parts of the kingdom, being fair in the S. and E., but very unsettled in the W. and N., with frequent falls of rain and thunderstorms in many places. Temperature was moderately high, especially in the S. There was rain on six days at Liverpool and Holyhead, five at York, four at Sheffield and Oxford, three at Spurn and London, and two at Yarmouth.

Sun Spots.

There were no spots on the sun from April 16th until the 29th, when there were four spots nearly half way across the disc. Two of these were small and situated to the north-east of the other two, which were larger, but none of them of very great size. On the 30th at 11 a.m. the spots were about the same distance from each other, but the lower ones were fainter and broken up into smaller spots, while at noon the spots had undergone further change, and the upper two had broken up or developed into six or eight very faint spots. On May 1st the spots were still visible, but very faint and almost indistinguishable. On the 2nd the sun was spotless, and no more spots were seen until the 9th, when there were some small ones near the eastern limb of the sun. These consisted of three spots forming a curve, with a larger spot behind preceded by three others slightly below it—altogether seven spots. On the 12th there were two spots close together, followed by some very faint and small spots, and these again by two moderately-sized spots, one above the other, the whole forming a curved line from east to west below the equator, and extending a considerable distance. On the 13th there was still a curved line of spots, but very faint, and on the 14th and 15th the sun was spotless.

The planet Venus is now a conspicuous object in the evening sky above the western horizon immediately after sunset, and it will be visible in the evening throughout the summer months. Two of the other planets are also now visible—Saturn, which sets about midnight, and is therefore in the west at sunset, and Mars, which rises at the beginning of June at 7-30 and about 5-30 at the end, and remains up till considerably after midnight, being in the southern part of our sky.

E. Howarth, F.R.A.S.

Museum and Observatory, Sheffield, May 21, 1890.

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Societies and their Work.

The Chester Society of Natural Science have arranged an attractive series of excursions for the summer months, the first of the season being that held on May 21st, to the Coombes, Broxton, specially for botanical and entomological work.

A meeting of the Manchester Geological Society was held at Wigan on May 9th, when Mr. James Tonge, F.G.S., read some "Notes on the Fossils of the Lancashire Coal Measures." Mr. G. S. Corlett exhibited a new form of electric signal for mining, and Mr. G. Hollingworth showed a tree branch found in drift at 40 yards deep, in the sinking of the Bredbury Collieries.

The following is a list of the localities selected by the Manchester Science and Art Teachers' Association for field meetings:—June 14th, Castleshaw Waterworks; June 28th (date subject to alteration), Manchester Aniline Company's Works, Clifton Junction; July 12th, Ashford, Derbyshire; August 9th, Staly Brushes.

Rambles have also been arranged as under by the Manchester Microscopical Society:—Lachford, Ashley, Poynton, Bramhall, Staly Brushes, Southport, West Kirby, and Port St. Mary. At the meeting of this society on May 1st, Mr. M. L. Sykes communicated a note on "The Cockchafer." Mr. J. E. Lord gave some "Notes on the Genus Distyla *(class Rotifera)*," and Mr. R. Parkes read a paper on "The Comatulidæ and their Parasites."

The annual meeting of the Liverpool Architectural Society was presided over by Mr. T. Mellard Reade, C.E., F.G.S., who was re-elected president of the society for the next session. Mr. Reade's address dealt with "Planning and Picturesqueness," in which he advocated bold and free planning to meet the requirements of a building and the exigencies of a site, without in the first place thinking too much of the exterior.

An unusually fine collection of tropical African insects, mostly *Lepidoptera*, was shown on behalf of Mr. William Watkins, of London, before the Leeds Naturalists' Club and Scientific Association. Some interesting notes on the capturing of these insects were given, and several illustrations of mimicry were pointed out.

The Derbyshire Natural History Society has now been amalgamated with the Archæological Society. The work of the society is subdivided into sections, Mr. H. Arnold Bemrose, M.A., being the chairman of that devoted to Natural History. Mr. Bemrose read, at the April meeting, an elaborate paper on the geology of Derbyshire, in which he reviewed the progress of geological work done in recent years, and gave suggestions as to what might be accomplished by the society in the future. Among the topics alluded to by the author, in his very exhaustive survey of the subject, were the researches made in the burrows and caves at Buxton, Cresswell Crags, and Longcliffe; the work done by Mr. Deeley in connection with the glacial drifts in the southern part of the county, and by Mr. H. T. Brown, Dr. Sorby, Mr. Wethered, and other geologists in relation to the elucidation of many important geological questions. The author referred with special emphasis to the necessity of preserving photographic records of the strata, as exposed in excavations or sinkings and natural features of the landscape, and recommended that work should be undertaken in this direction in connection with the British Association Committee on Geological Photographs.

Glacial questions have been attentively studied by the Leeds Geological Association, both theoretically by Dr. Lewkowitsch in his paper read before that society on "Ice and Glaciers," and practically in the course of field meetings to localities where the drift deposits were well examined. On April 26th a party of members inspected the fine section of boulder clay exposed in a brickyard at Laisterdyke, under the guidance of Mr. Thomas Tate, F.G.S. The section presents a tough, unstratified blue matrix, in which are included numerous fragments of grits, ganisters, ironstones, and coal. The beds are divisible into two groups.

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Reports of Societies.

Botany.

LINNÆAN SOCIETY OF LONDON.—At a recent meeting Sir John Lubbock gave a discourse on "The Form of the Leaf in the Oak and Guelder Rose, and on the Seed and Fruit of the Juglanseæ, and on Stipules," in the course of which he said :—

In the case of the oak, we are so accustomed to the form of its leaf that it does not strike us as anything peculiar, and comparatively few persons, probably, ask themselves why it should be as it is. And yet it is peculiar, unlike that of any of our forest trees and those of the evergreen oak, so abundant in hotter countries. In botanical phraseology, the oak leaves are deciduous, oblong-oblanceolate, or oblong-elliptical, sinuated with blunt-lobes extending not more than half-way down to the midrib. The sinus between the lobes is generally rounded off at the bottom. Again, they are rarely symmetrical, the lobes of the two sides not corresponding. The three points, then, which give the oak-leaf its peculiar form are :—(1) The deep rounded sinuses ; (2) the want of symmetry of the two sides : (3) the oblong or oblanceolate outline. I do not know of any attempt to explain this peculiar form. That which I would suggest is as follows :—The leaves of the evergreen oak are entire, and small in comparison with those of the English oak. During the winter and early spring they are protected by a series of brown scales, inside which they lie, and with which they form the well-known buds so familiar to us, and which are both small and short in proportion to the size of the leaves themselves. In cooler and moister regions, on the contrary, there is, as we know, a tendency for leaves to become larger and deciduous. These influences do not, however, affect the outer scales, which remain as before, without any increase of size. But as the leaves have increased in size and the scales have not, the leaves can no longer retain their original arrangement in the bud. If, for instance, we compare the buds of the oak and of the beech, we see that while the leaf of the oak is longer than that of the beech, the bud of the oak is, on the contrary, shorter than that of the beech. Under these circumstances, what must happen? The leaf grows and becomes longer than the bud. It is, therefore, necessarily bent into a curve. But an entire leaf, if thus thrown into a curve, would, necessarily, fall into folds, the number being determined by the number of ribs or veins. For such folds, however, there would be no room within the narrow limits of a bud, or rather, perhaps, they would be inconvenient, because they leave more or less empty spaces. This may be rendered more clear by taking a piece of cloth or of paper, folding it up, and then throwing it into a curve. It will then necessarily fall into one or more folds. If it were strengthened, as an oak leaf is, by three or four side-ribs, there would be a fold between each two ribs. As a matter of fact, however, from the absence of space the membrane where the fold would be is not actually developed. We may imitate this by removing them. If this be done the result will be the formation of sinuses rounded at the base, closely resembling those so characteristic of the oak leaf. These sinuses are due, then, as I believe, to the curvature of the leaf, owing to the shortness of the bud in comparison with the length of the leaf. The young leaf is not only curved, it is wrapped round the interior leaves. The result of this is that one side of the leaf is folded within the other, the one, therefore being on the outer side, has more space than the other. The two sides of the leaf are, in fact, differently situated, and this, I believe, accounts for the second point—namely, the want of symmetry. The oblong form is an advantage, from the way the leaves diverge from the stalk. In this manner the interesting peculiarities of the oak leaf may be accounted for. We have in this country two species of guelder rose—*viburnum*. They are nearly allied, but the leaves are very dissimilar, those of *viburnum lantana* being oval or ovate, and, when young, very hairy, those of *viburnum opulus* three-lobed, smooth, and provided with stipules. These differences are very interesting, but no one has ever attempted to explain them. The young leaves of *viburnum lantana* are sufficiently protected by their hairy covering, and are, consequently, left bare. This is not the case with *viburnum opulus*, in which the leaves are glabrous. The outer leaves, however, become tough and leathery, and form a covering within which the other or true leaves are developed. To economise space, these leaves are folded more or less like a fan, in the same manner as those of maples, sycamores, planes, &c., and this gives them their lobed form. As regards the stipules, the genus contains some fifty species, of which about forty have oval leaves without stipules, while the remainder have lobed leaves with stipules. The presence of these stipules seems, therefore, to go with that of the lobes. I believe that they assume that peculiar thread-like form so as to fill up a space which would otherwise be left empty in the bud. Maples have no stipules, but in them the younger leaves in the bud just fill up the interspaces left between the older ones. In the lobed-leaved guelder roses this is not the case, but a space remains, which is just occupied by the stipules. In a previous paper I have described the peculiar four-lobed cotyledons of *pterocarya*, and shown that this depends on the form of the seed, which resembles an anvil on four short stout legs. This form is again due to that of the fruit, the four projections of the seed having grown into four hollow spaces left in the solid woody tissue of the fruit. I have now to trace the gradual development of the fruit from the flower, and to compare the fruit of *pterocarya* with that of the walnut, in which, however, the hollow spaces developed in the fruit are much larger, so that, instead of a solid wall, with hollow spaces occupied by the seed, it gives the impression as if the seed was thrown into folds occupied by the wall of the fruit. To occupy these spaces fully the cotyledons themselves were thrown into folds as we now see them. The fruit of *pterocarya* is much smaller than that of the horse-chestnut, which was, doubtless, itself formerly not so large as it now is. As it increased, the cotyledons became fleshier, and found it more and more difficult to make their exit from the seed, until at last they have given up any attempt to do so. In regard to stipules, Vaucher, in his *Histoire Physiologique des Plantes*, speaking of *helianthemum*, says :—"*J'indique dans ce genre deux principaux objets de recherche. Le premier est la raison pour laquelle certaines espèces ont des stipules, tandes que d'autres en sont privées.*" No one, however, so far as I know, has yet attempted to answer this question, which, however, is one of considerable interest, and might be asked with reference to several other groups besides the genus *helianthemum*. In attempting to answer this question, we may begin by considering the function or functions which stipules perform. Of these, the primary purpose is to protect the bud. In others they serve as accessory (or deputy) leaves. As an illustration of the former may be mentioned some species of viola; of the latter certain species of *lathyrus*—for instance, *L. Mi solia*. The question may further be asked, What is the advantage to the plant in having the purpose of the leaves fulfilled by stipules instead of true leaves? Now, *L. Missolia* is a species which lives among grass. Here, then, the same considerations which render it an advantage to grasses to have long leaves affect equally the *lathyrus*. Again, if, when so growing, the leaves of *L. Missolia* had resembled those of most other *lathyrus*, they would, perhaps, have been dangerously conspicuous. The similarity of the stipules to the leaves of grasses by which they are surrounded perhaps enables them to escape observation, and to avoid being eaten. It may, indeed, be asked why the leaflets should not have assumed the long linear outline. But, even so, if they had been arranged at right angles to the petiole, the plant would have been much less grass-like, and, consequently, much more conspicuous than is now the case. This may, I think, be the reason which has led to the replacement of leaves by stipules in this species, and to the peculiar form which the latter have assumed. Passing on now to the cases in which the stipules serve to protect the young leaves, I may first mention those instances in which the stipules with this object have become stiff, pointed, or thorn-like, as in *robinia*. In far more numerous species, however, the stipules protect by enveloping the young bud and leaves. In such groups the view that the function of the stipules is mainly to protect the young leaf is confirmed, not to say proved, by the fact that they are very short-lived and drop off as soon as the young leaves have expanded. Such cases are numerous. Indeed, in many of the lesser-known genera this early fall of the stipules leaves it doubtful whether they occur or not. On the other hand, there are cases in which protective stipules are even more persistent than the leaves to which they belong. In such cases, however, they protect, not their own leaf, but that of the following year.

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Biology and Natural History.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—On April 21st Mr. J. W. Neville showed a series of lantern pictures illustrative of insect life. Of the thirteen orders into which insects were divided eight were said to be generally accepted, a few occupied debatable ground, and the others were so small as to be only known to specialists. Some of the pictures were drawn from dissections, and showed their minute structure as it appeared in the microscope.——On April 28th Mr. J. Madison exhibited fossil shells from Barton Cliff, and recent shells from Christchurch district; Mr. Deakin a trilobite and other fossils from Great Barr, also specimens of *Helix ericetorum* from Walsall; Mr. G. H. Carbett specimens of iron pyrites, marcasites, and arragonite from various localities; Mr. Linton birds' nests and fir cones coated with lime from the petrifying wells, Matlock. Under the microscope Mr. Hawkes showed a section through the spire head of *Equisetum arvense*. A paper was then read by Mr. S. White, entitled "Notes on Coalbrookdale and District." Coalbrookdale is famous for a great ironworks. From this starting point a series of rambles was made to Benthal Edge, Buildwas Abbey, Much Wenlock, Willy Hall, and Apley Park.——On May 5th several members exhibited fossils found during a ramble from Bescot to Pouk Hill. Mr. Deakin showed specimens of *Balea perversa* and other shells from the Isle of Wight; Mr.

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J. W. Neville fossil ferns from Coleford Mine; Mr. Linton butterflies from Zanzibar.——On May 12th Mr. Round read a paper on "The Geological History of Oldbury." After describing the manner in which sandstones, shales, and limestones found in the district were laid down, the writer dealt with the different seams of coal and the manner in which they were faulted. When 200 feet of beds had been deposited on the coal an eruption took place, covering a considerable area with lava and forming the Rowley Hills. The changes that have taken place since that period were enumerated, and the evidence of the sea having washed the base of the Rowley Hills enlarged upon. The paper was illustrated by a series of carefully-prepared diagrams.

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Sheffield Naturalists' Club.—On April 17th Mr. G. R. Vine gave a lecture on "Ocean Débris," in which he described many interesting microscopic forms discovered by him in some of the older rocks. For some years past Mr. Vine has had submitted to him for study "debris" from different geological horizons. Some material from the Richmond boring, near London, enabled his report on the Polyzoa of the Great Oolite. Afterwards, some Gayton boring "débris" afforded him an opportunity of studying the peculiar microscopic organisms of an ancient sea beach formed during the deposition of carboniferous rocks below Northampton. The most abundant of material studied, however, was derived from Upper Silurian rocks in Shropshire. These Wenlock shales were nothing less than "débris" which had been piled up by old ocean's waves and storms that had for ages been silent; yet, locked up in the waste, were remnants of a fauna that had been almost as widespread in its distribution as the ancient seas themselves. Instances were given which proved that organic forms—such as Entomostraca, Polyzoa, fragments of Trilobites, and innumerable Brachiopoda—were found in the Shropshire shales similar to those of Sweden on the one side, and the Upper Silurian rocks of North America on the other. The "débris" examined—which was kindly furnished to Mr. Vine by Mr. George Maw—were washings of about twenty-three tons of shale from several localities, such as the Tickwood, Coalbrookdale, and Buildwas beds; in the first and last of these minute organic forms could be picked out by thousands. After several years' labour the Entomostraca alone enabled, by Mr. Vine's request, Professor T. Rupert Jones to add considerably to the list of Silurian Ostracoda, while the lecturer himself furnished to the London Geological and other societies papers on the Polyzoa and the Annelida tubicola of these shales.—— On May 8th, Mr. Arnold T. Watson delivered a lecture on "Early Architects, or Studies of the Habits of Tube-Building Worms." These worms are, practically, all inhabitants of the sea. The majority of them are sedentary worms, living upon the nutriment extracted from mud and decaying vegetable matter, though there are certain of the Errantia (animal killers) which occasionally protect themselves with tubes. Such a worm is the *Polynoe scolopendrina*, which is frequently found in the company of *Terebellæ*, and forms a tubular case constructed of sand and fragments of shell agglutinated together. Mr. Sinel, of Jersey, who had supplied the lecturer with specimens, states that he has often found *Lineus marinus* in tubes of great hardness, hard as concrete, like pieces of stoneware jar, covered outside with bits of gravel, and sometimes large stones; *Meckelia annulata*, attached to the under sides of stones, in tubes lax and gravelly, like those of *Terebella nebulosa*; also *Clymene borea'e*, *Eunice Havarsii*, and others in tubes of various kinds, of which they were themselves the makers. The various sedentary worms, *Spio* boring into the hardest flint and constructing a minute fragile tube upon the surface; *Chætopterus*, with its peculiar membraneous tube and curious appendages; *Terebellæ*, with their tubes of masonry; *Sabellæ*, with homes sometimes coated with stone, but generally mud; *Sabellaria*, the builders of the large beautiful masses, popularly known as "rock coral;" *Pectinaria*, the most perfect of stone-masons; with *Serpulæ* and *Spirorbis*, the builders of calcareous tubes, were described, and their method of work explained. The most interesting portion of the lecture had reference to these tubes, the mode in which they had been built by the worms being fully described. This, in the case of the plain portion of the tube, can be readily seen by a careful observer, but the observation of how the sandy fringe is built is a most difficult matter, and was only attained by about fourteen days' almost constant watching. In the building of the fringe a moderately-large grain of sand is first laid as a foundation, then the creature usually retires into its tube, and the tentacles collect and carry down a supply of grains of sand which is received by the lips of the worm, and no doubt duly coated with the secreted transparent cement. The animal then slowly emerges and lays first one grain upon the foundation-stone; then, whilst still holding this with the lower portion of its lip, it forces a second grain above the first through the upper portion of its lip. It then slides its lip forward to the second grain, which it holds as before, passing forward above it a third grain, and so on until the whole supply of sand, perhaps half-a-dozen grains, is exhausted, the worm keeping hold with its lips all the time, and retiring at lightning speed when the last grain is laid, the whole operation occupying from five to ten seconds only. These operations are chiefly carried on during the night, and many hours, or even days, may elapse between each favourable opportunity for observation. As regards the object of this fringe, Mr. Watson suggested that it might possibly be a snare to catch food; or the filament might form a favourable vantage point from which the animal can fish around with its tentacles.

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Ealing Microscopical and Natural History Society.—Mr. F. E. Beddard, Prosector to the Zoological Society, recently lectured at Ealing on the subject of "The Colouration of Animals." He explained that animals were coloured according to two principles. There might be definite pigments contained in the skin, or colours might be caused by structural features, and therefore due to optical causes. In most invertebrate and in many vertebrate animals, colour was due to the presence of definite pigments. Thus, the gorgeous colour of a bird of Paradise was caused by orange-coloured pigments in the feathers. This was also the case with the cassowary, whose colour was due to the presence of definite pigments in the skin. In other cases the colour was due to mechanical causes. This could be easily demonstrated in the case of a feather by examining it by a light passing through it, when it would be found that instead of exhibiting gorgeous colours it would appear of a dusky colour. That being the case, they had first to inquire into the causes which brought about the colouration of animals, or whether it could be referred to any cause at all. One of the early views advanced to account for this was that it was due to the presence of light. That view held good in a few cases. Most people were aware that plants were coloured green by a substance which required daylight for its existence. But there were exceptions to this, and the most notable exception was the case of the seedling of the pine. Animals which lived in caves were almost invariably greyish or brownish in colour. But that colour was not due to the presence of light was shown by deep-sea animals. The average depth of ocean beds was three miles. Great oceans teamed with living organisms, and the explorations made during the voyage of the "Challenger" had proved that these living organisms extended down to a considerable depth below the surface. These shut out the light, and prevented it reaching the lower depths of the ocean, which must, therefore, be dark with a darkness of which no conception could be formed. If, therefore, colour depended upon light, they would expect to find an absence of colouration in the animals at the bottom of the ocean. So far from that being the case, however, they were found to be more brightly coloured than those met with in shallow water. An ingenious theory was put forward to account for this by the late Sir Wyville Thomson, who based his views upon the fact that many animals which lived at the

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bottom of the sea were phosphorescent. Fishes themselves were luminous, and deep-sea fishes were studded with organs which produced light; and it was urged that this was sufficient to account for the presence of colour. But another hypothesis had been advanced, viz., that luminous animals and insects such as the glow-worm were luminous for the purpose of warning off their foes. Looking at all the facts, they must come to the conclusion that colour was not dependent upon light. Many deep sea animals, however, had no trace of eyes at all. Half of the inhabitants of the deep sea were without eyes, half of the remainder had degenerate eyes, while the remainder were furnished with well-developed eyes. They must, therefore, conclude, as he had said, that in the deep sea colour could not be seen. Dealing with other theories, Mr. Beddard mentioned that of protective colouration, it being held that certain animals were of a distinctive colour to enable them to protect and conceal themselves from their foes. One instance of this was the chameleon, and in reference to the general idea that this animal could change its colour at will, the lecturer remarked that experiments in physiology had shown that change in colour was a mere reflex action. Another remarkable class of colouration was that of warning colours. While the colour of many animals harmonised with their surroundings, that of others did not. The wasp and the hornet were most conspicuously coloured and both posesssed a sting, and their colours, it was supposed, were intend for warning purposes. A striking instance of this warning colouration was also seen in the case of the Helodeim lizard. There was also the theory of sexual selection in colouration. In many birds the colouration reached its maximum in the male sex, while in the female there was scarcely any.

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Liverpool Naturalists' Field Club.—On April 24th Mr. J. J. Fitzpatrick read an interesting paper on "Bone Caves," in which he gave an account of the principal bone caves in England and Wales, and made special reference to his own investigations of a recently-discovered cave and series of chambers in Derbyshire.——On May 3rd the first field meeting was held at Helsby and Frodsham, when about 70 members attended, some of whom explored the Weaver valley; the greater number proceeded to Helsby, and were met at the station by the Rev. W. T. Vale (the vicar) and Mr. Holland, who acted as guides across the hills to Frodsham. On the way the ornamental grounds of "Fox Hill" were visited, by permission of Jas. Reynolds, Esq., whose kindness was much appreciated. There were no special botanical finds to record. ——On May 8th an evening meeting was held at Bromborough and Raby. About 40 members attended, under the leadership of Mr. Brown. Amongst the best plants found in flower were *Viola palustris* (marsh violet) and *Lathyrus macrorrhizus* (tuberous vetch).

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Wakefield Naturalists' Society.—At the May meeting of this society a paper was read by Mr. H. G. Townsend on the "Mountain Limestone of Derbyshire," in which the author pointed out that the most beautiful scenery in Derbyshire is to be found where this formation prevails, its rocks rising in steep cliffs and broken crags, or in rounded and often wooden slopes, bordering those beautiful dales, with their rapid trout streams, which are the pride of the county. The mountain limestone possesses a certain range of mineralogical characters scarcely to be recognised in any of the younger calcareous deposits, and is usually a pure carbonate of lime of a greyish or even blue tint, with an imperfect conchoidal fracture. The traps, or toadstones, appear to lie in three beds varying in thickness and sometimes dying out altogether; part of it is an extremely hard and dense basalt, while another is an amygdaloid with its cavities filled with calcite and other minerals. The dales of Derbyshire were probably in many instances originally caverns, which have been through countless ages eaten away by the streams till at length the roofs have fallen in, and in their turn have been for the most part carried away by the same powerful agent. The products of the mountain limestone are many and valuable, among which may be mentioned its marbles; the famous black variety being quarried at Ashford, and the encrinital marble worked at Monyash Quarries. Of its metallic ores, galena, a lead sulphide, is the most important, containing a good percentage of silver. The mineral barytes is largely manufactured for the adulteration of white lead, while fluor spar, commonly called Blue John, is extensively worked up for ornaments. Coal has been found in the limestone itself at Combes Dale, near Stoney Middleton, thus showing that towards the close of the Mountain Limestone period those ages which afterwards produced the great coal formation were already at work, and serving to connect the limestone of central England with its relative in the north, which perhaps represents the margin of that sea in which the purer limestones were deposited.

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Engineering.

Yorkshire College Engineering Society.—At a recent meeting Mr. B. Holgate, F.G.S., gave a lecture on "Timber: its Structure, Growth, and Uses." Mr. Holgate advanced the subject as one not devoid of interest to engineers. Although iron has now, in a great measure, taken the place of wood and stone, yet the introduction of so many kinds of foreign timber into this country has made it the more necessary for engineers (in order to give themselves freer choice for selection) to make themselves acquainted with the qualities of these numerous kinds of timbers. All wood is not "timber." There are in foreign forests gigantic tree-ferns growing which are totally unsuited for use as timber. These tree-ferns are built up in a much lighter fashion than the wood we use. Another kind of wood (the kind to which the palms belong) is also not fitted for use as timber, though its size is great, for its vessels and woody bundles are arranged in an entirely different manner from that of the "timber" trees. The sap circulates in a different way; it has no rings of growth and no bark. The simplest kinds of trees useable as "timber" are the larches, the pines, the firs, and allied trees. These trees fruit, as a rule, in cones; they increase in diameter by rings of growth; and they possess bark. All the vessels and wood bundles of which the tree is composed are arranged lengthways of the tree; and they do not possess those horizontal bars or cells of tissue which are so clearly seen to run from the centre outwards in such woods as the oak, ash, beech, &c. The remaining kinds of "timber" trees, such as those last named and many others, are built up like a solid woven fabric, consisting of vessels and woody bundles running lengthways of the tree; while other vessels, the medullary rays, are, as it were, woven in between them from the centre outwards. These trees increase in size by rings of growth, and have bark, the sap circulating inside the bark. One ring is as a rule added per annum. Whether this is strictly so or not, the rings mark a period commencing with a fresh and rapid growth of open and weak material such as we might expect in the freshness of spring; and the ring becomes more and more dense as its growth goes on more slowly, until it comes to a period of almost perfect rest in winter. One of the faults of timber, and one of the worst kind, comes about when the tree has had a succession of dry seasons, followed by a wet one. The tree then forms a large quantity of weak wood—so weak that as the growth progresses outwards it is detached at the weak part of the ring from the previous growths, forming what is known as a "ring shake." Speaking of soils, the lecturer said that from a very ancient time in the world's history trees allied to the larches, pines, &c., had grown on the steep hill-sides of northern Europe. We find broken pieces of this timber as far back as the coal measures, and the structure is very similar to the structure of those of the present day. These trees are particularly suited for grit rocks, or sandy soil in which water does not stay long. Their roots never penetrate more than about two feet into the ground, running horizontally just beneath the surface. It is evident that these trees will often be in want of a supply of water derivable from their

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roots; but if we examine their leaves we shall find that this is compensated for by the foliage being divided into numerous fine spines, so as to present an immense surface to the atmosphere, to which they are in a great measure indebted for their sustenance. Other trees, such as the oak and the apple, grow best and make the best timber in clayey, cold soil; whilst others, such as the ash, &c., prefer a rich soil.

Entomology.

LANCASHIRE AND CHESHIRE ENTOMOLOGICAL SOCIETY.—On May 12th the president (Mr. S. J. Capper, F.L.S.), read a communication from Mr. C. S. Gregson, who sent two specimens of the glow-worm, *Lampyris noctiluca*, from New Ferry. Mr. Robert Newstead, Curator of the Grosvenor Museum, Chester, read a paper on "Local Injurious Insects, with notes on the currant-bud mite, *Phytoptus ribis*," illustrating his remarks with large drawings and beautifully-prepared cases of life histories of actual specimens. The author, in speaking of the ignorance among farmers, recounted how a certain grower had actually distributed cuttings from currant trees infested with *P. ribis* to friends, believing them to be a fine variety of the currant tree, thus spreading the disease. Mr. Newstead also gave a full account and best means of prevention and cure of the new flour moth, *Ephestia Kuhniella*, the ash bark scale, *Chionaspis fraxini*, &c., and exhibited specimens with drawings, of *Pulvinaria ribesiæ*, the woody scale insect of the currant, the male of which was unknown until discovered by him on April 7th of this year. The president exhibited some fine varieties of *Polyommatus phlacas*, including the variety *Schmidtis*, with intermediate forms. Mr. E. D. Fish brought samples of leather which were riddled with holes, caused by the warble fly, *Hypoderma bovis*, breeding in the back of the beast during life, and pointed out how easily this loss could be prevented. Mr. W. Gardner showed fossil remains of *Orthoptera* and *Neuroptera* from the Blue Lias, Warwickshire.

Geology.

GEOLOGICAL SOCIETY OF LONDON.—At the meeting on 16th April, the following communications were read:—"On the Disturbed Rocks of North-Western Germany," by Prof. A. von Könen; "On the Origin of the Basins of the Great Lakes of America," by Prof. J. W. Spencer, State Geologist of Georgia. The author showed that the original Erie valley drained into the extreme western bed of Lake Ontario—the Niagara river being modern—by a channel now partly buried in drift. Lake Huron, by way of Georgian Bay, was a valley continuous with that of Lake Ontario. Other buried fragments of a great ancient valley and its tributaries are connected with submerged channels in Lakes Huron and Ontario, thus forming the course of the ancient St. Lawrence (Laurentian) river. Some of the lakes have been formed in part by drift obstructing the old valley. The author attributed the origin of the basins of the great lakes to these ancient valleys, obstructed during the Pleistocene period by terrestial movements producing lake-basins. Papers were also read on "Ornithosaurian Remains from the Oxford Clay of Northampton," by R. Lydekker, B.A.; and "Notes on a 'Wash-out,' found in the Pleasley and Teversall Collieries, Derbyshire and Nottinghamshire," by J. C. B. Hendy. On April 30th Mr. D. Pidgeon read a paper on "Physical Peculiarities Exhibited by the so-called 'Raised Beaches' of Hope's Nose and the Thatcher rock, Devon;" followed by a communication on "The Devonian Rocks of South Devon,' by W. A. E. Ussher, F.G.S., having special reference to the area north of the Dart and east of Dartmoor.

LIVERPOOL GEOLOGICAL ASSOCIATION.—The ordinary meeting of this association was held on the 5th May, Mr. W. H. Miles in the chair. A paper was read by Mr. H. C. Beasley on "A Visit to Warwick," in which he lightly sketched the characters of the new red sandstone in that neighbourhood, and gave an account of the various fossils displayed in the Triassic collection at Warwick Museum, and as found by him in the local quarries. Mr. J. Butler Davies, who followed with some geological "Notes from the Dingle Shore," had the advantage of describing a district rich in local historical associations, as well as instructive to the student of nature. His notes concerning the red sandstones of Dingle Point, the strange dislocations they had undergone, and the far-travelled contents of the boulder clays on the same shore furnished ample material for discussion.——A field meeting was held on May 10th last at the works of the Manchester Ship Canal, the section visited being that exposed between Ellesmere Port and Eastham. A short distance from Ellesmere Port the cutting commences in the "pebble beds," which dip in a north-westerly direction and merge nearer Eastham in the "Upper Mottled Sand-tone," the whole appearing to form an unbroken series of the Upper Bunter division of the Trias formation. The beds are capped by the drift deposits of boulder clay and sand. Some curious water-worn, flask-shaped hollows, about two feet in diameter, were discovered in the clay, and were suggestive of the "potholes" found in limestone districts. Near the "Pool rocks," about half way from Ellesmere Port, the rock disappears and only the drift is exposed. This is probably due to the existence of one of the old pre-glacial valleys or gulleys which formerly existed when what is now the estuary of the Mersey was a fresh-water stream. During the Glacial period these became filled up with sand and clay, subsequently becoming partly re-excavated by the action of the streams which again flowed in the direction of their old channels, and gave rise to the numerous pools found on the Mersey. Near this point the drift deposits contain some interesting features, the beds of clay alternating with others of sand and gravel; one stratified patch of sand noticed had a dip at a considerable angle to that of the surrounding clay. These features will soon be lost to view, as the bank is being covered with a stone casing. Further on the rock is again exposed, and contains some beds of a micaceous sandstone of a flaggy character (Upper Mottled Sandstone). The field meeting concluded with an inspection of the locks now in course of construction at the Eastham end of the canal.

General Science.

UNIVERSITY COLLEGE, BANGOR, SCIENTIFIC SOCIETY.—On April 19th Mr. Edward Spencer read to the society a paper on "Smell and Perfume," in which he drew attention to the inferior position and the great and continued want of education of the olfactory sense, and, what was almost a necessary consequence, the accumulation of so little accurate scientific information on the subject. After describing the organs of smell in man, the course of an olfactory impulse from the olfactory cell in the nose to the receptive cell in the cortex cerebri, he proceeded to the objective part of the subject. He first showed that gases alone were odorous, and, proceeding to classify them, he pointed out that the compounds of certain elements only could be recognised by the nose; that there was a higher limit to the sense, for no gas with a molecular weight of less than 15 had a smell, and that individuals varied as regarded this limit. He then drew attention to the useful perfumes of the animal and vegetable kingdom, although he was able only in comparatively few cases to assign to a particular substance the smell of a plant. He alluded to the fact that all plants which owed their perfume to the essential oil they secreted were sanitary in their action.—— On Saturday, May 10th, the seventh meeting of the session was held, the honorary president, Professor Gray, in the chair. Miss Miall read a paper on "Micorhizas," and their operation in the fixation of nitrogen. The following is an abstract:—

The problem how to obtain nitrogen for plants at a cheap rate has long been puzzling the farmer. The free nitrogen of the air is of no use to plants, as was proved by Boussingault. The German botanist, Frank, has discovered a fungus growing on the roots of the *Cupuliferæ* (hazel, beech, &c.), which he believes per-

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forms the function of root-hairs for the root. It thrives in the region in which root-hairs are normally found, and roots bearing the fungus produce no root-hairs, and yet the tree seems quite healthy. This combination of root and fungus for the mutual advantage of each he calls a micorhiza. He believes that the fungus is specially employed in transferring nitrogenous substances to the root, and that it enables the plant to take up compounds which it could not otherwise make use of (humus, decayed leaves, &c., seem specially useful). Later researches have lead Frank to the conclusion that there are a great many more micorhizas than he at first supposed. Thus, he has found the fungus on the roots of the larch, Scotch pine, lime, birch, &c., and he believes it is present on all trees under certain conditions. He would also include the plants of the *Leguminosæ*. But Professor Marshall Ward refuses to adopt this view, since these plants develop root-hairs and appear to absorb substances from the soil like normal roots. That these plants have some unusual method of securing nitrogen, however, has long been known, and that instead of decreasing the quantity of combined nitrogen in the soil, they increase it. From experiments of Hellriegel, it seems clear that this faculty is due to a fungus which causes swellings (tubercles) in the tissues of their roots; and, further, that when deprived of all nitrogen except that free in the air, plants containing these tubercles are enabled in some way to combine or fix the free nitrogen, and use it for their physiological processes.

The paper was illustrated by diagrams of micorhizas taken from Franks' papers. Professor Gray read a communication on the recent researches of G. B. Schiaparelli, made at the Milan Observatory, "On the Rotation and Physical Condition of the Planet Mercury;" he said:—

Schiaparelli has overcome the difficulties of observing this planet, which are due to its proximity to the sun and to the fact that it can only be observed in full daylight and through an atmosphere which is constantly illuminated. He carried out a continuous series of observations on the spots of Mercury by means of the new large refractor which has recently been installed at Milan. With regard to the rotation of the planet, he finds that the motion of Mercury round the sun is similar to that of our moon round the earth, and that it always presents the same hemisphere to the sun. It, however, possesses a greater "libration of longitude." Hence three-eighths of the planet's surface is continually in the blaze of the sun, and an observer in this region sees the sun oscillate in the sky over an arc of 47°, the double oscillation taking a period of 83 earth-days. Another three-eighths of the planet's surface is turned away from the sun, and is consequently in continual darkness, being only illuminated by refracted rays and twilights. In the intervening tract of one quarter of the surface there is a single alternation day and night during each interval of 88 days, the length of the day and of the night varying at each place according to its position, but constant for the same place. The possibility of the existence of organic life will depend upon the existence of an atmosphere capable of distributing the sun's warmth. Schiaparelli thinks he has discovered indications of an atmosphere in white clouds appearing as bright spots, and rendering the image of the spots indistinct. He supposes the dark spots to be tracts of water, and these he finds are not aggregated into large tracts forming oceans, but appear to branch and ramify through the land as canals. Such an alternation of land and water he thinks would cause a more complete equilibrium of temperature. The peculiarity in the rotation of Mercury is an exception among the planets, but common among the satellites of planets. Mercury has no satellite, so that it presents a remarkable divergence from the prevalent condition among the planets.

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Institution of Naval Architects.—The members of this institution resumed their sittings on March 28th, at the Hall of the Society of Arts, the Earl of Ravensworth in the chair. A paper "On Leak-Stopping in Steel Ships," by Captain C. C. Penrose Fitzgerald, was read, and a discussion took place upon the experiments proposed to be made. Mr T. C. Read communicated a note "On the Variation of the Stresses on Vessels at Sea Due to Wave Motion." At the afternoon sitting Professor V. B. Lewes read a paper upon "The Spontaneous Ignition of Coal Cargoes." He said that, from 1875 to 1883, 57 coal-laden vessels were known to have been lost from the spontaneous ignition of their cargoes, while during the same period 328 were missing from unknown causes, a large percentage of these losses being undoubtedly due to the same cause; and these formed but a very small percentage of the cases in which cargoes had heated and fired, but in which the vessels had been saved. Under these circumstances Mr Martell had suggested to him that an inquiry into the causes and possible prevention of the curious evil would be acceptable, and he now brought before them the results obtained in a long series of experiments. Of the constituents of coal he found that the only ones which played no part in the phenomena attending heating and spontaneous ignition were the mineral constituents other than pyrites, and they, therefore, had to deal with the chemical actions which took place when the carbon, hydro-carbon, and brasses contained in newly-won coal came into contact with air and moisture. He referred in detail to the influence of carbon in producing heat, the action of the bituminous constituents of the coal in spontaneous ignition, and the action of iron disulphide, pyrites, or coal brasses in promoting it. The coal first shot into the vessel, by reason of the distance it had to fall, was broken into small lumps, and, having to bear the impact of the succeeding loads falling upon it rapidly, became powdered into slack, so that by the time the cargo was all taken in a dense mass of small coal was to be found under the hatchway. It was invariably at that point that heating took place, as the large surface exposed fresh to the air by breaking down of the coal caused rapid absorption of oxygen and consequent rise of temperature. He found that liability to ignition increased with the tonnage of cargoes. The larger the cargo the more non-conducting material was there between the spot at which heating was taking place, and the cooling influence of the outer air, and the larger the cargo the greater would be the breaking-down action of the impact of coal coming down the shoot in loading. Referring to various kinds of coal, he thought that cases of ignition were more frequent in that shipped from East Coast ports than from South Wales, and upon the subject of ventilation he said this was undoubtedly one of the most prolific causes of spontaneous ignition, as the ordinary methods supplied just the amount of air to create the maximum amount of heating. He asserted that the rise in temperature in steam colliers was due to the introduction of the triple expansion engines and high-pressure boilers. Proceeding to enumerate the precautions to be taken to avert disaster, he suggested that the coal should be as large as possible, that no coal should be shipped to distant ports until at least a month after its arrival at the pit's mouth, and that it be shipped as dry as possible. The coal compartments should be made gas tight, and when the cargo had been taken in it should be battened down, and the hatches should not be opened until the destination was reached, the only ventilation allowable being a two-inch pipe inserted into the crown of each compartment, and led twelve feet up to the nearest mast. Into the body of the coal cargo should be screwed, at regular intervals of about six feet, iron pipes closed at the bottom, and containing alarm thermometers. As soon as the alarm thermometers gave notice that heating had reached a dangerous point the valves could be opened, and the lower portion of the cargo drenched with water. The lecturer made a series of interesting experiments illustrating the cause of spontaneous ignition, and showing how carbonic acid gas, compressed under a pressure of 36 atmospheres into a liquid state, could be placed in steel vessels with fusible plugs and introduced into coal cargoes. On these plugs melting, the liquid would be converted into gas, and a large amount of heat absorbed, thus at once lowering the temperature of the coal in process of ignition. This was the means he suggested for the prevention of undue heating.

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Reviews.

The Flora of Derbyshire. By the Rev. W. H. Painter. [London: G. Bell and Sons. Derby: E. Clulow, Jun.]

This work gives a brief description of the physical features of Derbyshire, and a list of all the flowering plants and ferns found therein, with their principal habitats. The plant descriptions are clear and concise, and the whole work is well adapted as a guide to botanists and other scientific students who wish to study the natural history of this interesting and charming county.

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A History of British Birds: their Nests and Eggs. By S. L. Mosley, F.E.S. No. 63, April, 1890.

THE great beauty of the plates in this work, all of which are coloured by hand, will secure the attention of all ornithologists. Illustrations are given in the present part of the redshank, spotted redshank, and greenshank, with their eggs, accompanied by full descriptive details.

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Studies in Evolution and Biology, by Alice Bodington. [London: Elliot Stock.]

IN the preface we are told that this little book "ventures to indicate what a great work lies ready for the man of genius who will do for science what Motley and Freeman have done for history." It contains several well-digested articles on many interesting biological topics written in a style calculated to lead the reader to further investigation, and is in many ways remarkably well fitted to serve as an introduction to biological studies.

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Glimpses of Nature's Secrets, or Strolls on Beach and Down, by Edward A. Martin. [London: Elliot Stock.]

THIS is a useful little work, giving interesting descriptions of the life history of many of the natural history objects of the sea shore. It also contains well-written chapters on popular geology. To those who wish for a clearly-written description, devoid of unnecessary technical terms, of the objects they meet with in their rambles on the sea shore or in their country walks, this little work should prove very valuable.

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Bulletin of the Geological Society of America. Vol. i. [Washington, U.S., April, 1890.]

A PAPER on "The Pleistocene Flora of Canada," by Sir William Dawson, F.G.S., and Professor D. P. Penhallow, F.R.S.C., appears in this number of the *Bulletin*. It contains an account of the general geology of the Pleistocene, with references to the special localities of fossil plants, and a note on the geographical and climatalogical conditions. The plants found have been submitted to Professor Penhallow, who appends his report upon them. Dr. Dawson is of opinion that they indicate a cold temperate, rather than an Arctic, flora. They scarcely indicate so much refrigeration as that evidenced by the plants from British interglacial beds, as described by Carruthers.

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Electrical Engineering for Electric Light Artizans and Students. By W. Slingo and A. Brooker. [London: Longmans Green and Co., 1890.]

ELECTRICAL engineering as a profession is the product of the last few years, and the rapid strides which have been made in the application of electricity to lighting and various other purposes have, in that time, followed so closely upon each other that it is no wonder that it has been found impossible for most students of the science to keep abreast of the numerous important developments. But the great extension of electric light installations and of telegraphic and telephonic systems has called into existence a special class of skilled workmen, for whom it is desirable to provide facilities for making themselves acquainted not merely with the practice, but also with the principles, of their work. And it must often happen that when electricity is being so extensively introduced into our houses, our offices, and our factories, into our railways and our ships, it necessarily comes to be more or less under the supervision of persons who have not had any special electrical training, but who have the desire to know something of the general principles of the arrangements in connection with this valuable agent. From all such persons, as well as from that section of the general public which takes an intelligent interest in physical science, this useful handbook on electrical engineering, by Messrs. Slingo and Barker, should receive a very cordial welcome. The authors have both an intimate practical acquaintance with their subject and also experience in teaching, so that they are able to expound in a very clear and concise manner the principles of the various branches with which they undertake to deal. The work does not treat of electricity in the usual manner of the ordinary text-books; and in order to follow it intelligently it is necessary that the student should have some previous knowledge of the simple experimental side of the subject as it is usually set forth in elementary text-books or classes. Such a chapter as that on primary batteries, for example, while clearly stating the theory of the various arrangements, also contains a large amount of very practical information about details, which are evidently the result of practical experience, but which the student would look for in vain in the ordinary text-book. A large part of the earlier chapters is taken up by the explanation of the various terms used in practice, and a very practical account of the various units employed in the measurement of electrical quantities. The explanations are very largely based upon Ohm's law, and are reduced to so simple and clear a form that a very slight acquaintance with mathematics is all that is required to fully understand them. Clear descriptions are given of a large number of the instruments employed in the measurement of electro-motive force, of the strength of currents, and of the resistance of conductors; and the principles on which they are constructed are explained. An excellent chapter on electro-magnets follows, in which, by the important and extensive use which is made of Faraday's idea of lines of force, the subject is made very clear in a way which will be appreciated by practical men. Descriptions are given of most of the important dynamos and motors in their most modern forms. Chapters on transformers and secondary batteries are followed by very good descriptions of various kinds of arc and incandescent lamps, the principles underlying the construction and use of these being fully explained, as are also those involved in the various methods by which the intensity of the light given out by these lamps is estimated. The last chapter contains a succinct and clear account of the practical installation, the dispositions of the mains and branches, and the nature and construction of switches, safety fuses, and meters. Altogether the work is one which may be highly recommended, as providing all persons interested directly or indirectly in the progress of that branch of electrical engineering which deals especially with lighting and the transmission of power, with a thoroughly clear, practical, and reliable text-book. It should be added that the book is very well illustrated by diagrams and by drawings of the various instruments and machines. W. H.

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A Contribution to the Pterylography of Birds' Wings. By W. P. Pycraft. [Leicester: George Gibbons & Co.]

THE author of this pamphlet has assiduously followed up the researches commenced by the curator of the Town Museum at Leicester (Mr. Montagu Browne, F.G.S.) in the pterylography of the wings of birds, and he has succeeded in adding a valuable series to the "Index" collections of that museum, to which Professor Flower on a recent visit accorded his warm appreciation. In the present work Mr. Pycraft commits to print the result of his labours. He shows that he has familiarised himself with the somewhat scanty literature of the subject, and has endeavoured to reconcile the descriptions given in many cases with the conditions obtaining in the actual specimens. As might be expected, he has found that many interesting features have been overlooked and in some cases wrong conclusions arrived at. The author recalls the work done by other naturalists in the same direction, and gives a useful digest of what has been previously published on the subject, pointing out, in many instances, the result of his own more perfect and complete observations on the structure and development of the wing in different species of birds. Ornithologists will be indebted to Mr. Pycraft for his interesting *resumé* of the subject.

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The Naturalists' Calendar and Weather Guide. Compiled by the Editor of *The Naturalists' Gazette.* [Birmingham Naturalists' Publishing Co.]

THIS is a useful little handbook giving a selected list of periodical natural phenomena in the probable order of occurrence for each month in the year. Names of the plants, insects, birds, and mammals which are to be observed each month are given, with short notes on their habits. The lists are printed in a form handy for reference. Some notes are added on "Plants and Animals as Weather Guides," and a table is given detailing the hours at which in ordinary fine weather the common flowers of the field open and close their petals.

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Transactions of Societies.

Transactions of the Manchester Geological Society. Part xviii., vol. xx.

THE contents of this part are devoted to the paper read at the March meeting by Professor W. Boyd Dawkins on "The Discovery of Coal Measures near Dover," a report of which has already appeared in our columns. In answer to one of the speakers in the discussion, Professor

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Dawkins stated that the facts of finding *calamites*, and seeing well-defined cores of underclay, were conclusive as to the boring having reached the true coal measures.

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Transactions of the Historic Society of Lancashire and Cheshire. Vol. xl., for the year 1888. [Liverpool: Printed for the Society. 1890.]

THE present is one of the best volumes of *Transactions* which this old-established society has issued for some years. The illustrations are lavish, those illustrating Mr. J. P. Ryland's paper on "Book Plates (*ex libris*), with special reference to those of Lancashire and Cheshire," being exceptionally well executed. A list of local examples is added to the paper. Mr. J. P. Earwaker contributes a note on the interesting ancient establishment of the "Mock Corporation" at Rochdale. Mr. E. W. Cox gives an account of the ancient chapel of St. Michael, Garston, which has now passed into oblivion, or, rather, which would have been lost had not the author rescued sundry fragments of the building, from which he has been enabled, by a process akin to that of the comparative anatomist, to reconstruct its architectural features. Several well-executed plans and some lithographed sketches embellish this paper, which is a remarkable record of the perseverance of its author in reclaiming a fragment of local history from the few disinterred remains of an ancient and almost forgotten structure. In a paper on the antiquities of the Cheshire shore, Mr. Chas. Potter returns to the scene of his investigations, whence he has already derived a large collection of pre-historic objects and relics of the early history of the peninsula of Wirral. From Roman down to mediæval times this tract of country was inhabited by a people largely of agricultural habits, who have left their records in the specimens of spades, forks, ploughs, and ornaments discovered from time to time along the Meols shore.

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Transactions of the Manchester Microscopical Society. 1889.

A GOOD portrait of Mr. William Blackburn, president of this society in 1883, forms the frontispiece to an admirable volume of *Transactions*, which comprises, besides the official annual report of the council, addresses by the president (Dr. A. Milnes Marshall) on "The Shapes and Sizes of Animals;" by Professor L. C. Miall, of Leeds, on "Chironomus;" and several papers of interest read before the society. "The Recent Foraminifera of Jersey," by E. Halkyard, is illustrated by figures and drawings of a terrestial alga, *Prasiola crispa*, accompany a paper on the subject by Mr. J. J. Newton.

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Obituary.

WE much regret to record the loss of another valued contributor to our journal, through the death of Mr. RICHARD HOLLAND, who expired suddenly on the 20th ult., in his thirty-ninth year. The deceased was well known in literary and musical as well as in mercantile circles. He was for some years representative in Liverpool of *Lloyds' List* and *The Shipping Gazette*, and contributed many articles of interest to our columns, besides those of *Cassell's Magazine*, *Chambers' Journal*, and other periodicals.

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Letter to the Editor.

DEPOSITS OF VOLCANIC DUST IN BARBADOES.

SIR,—The fall of volcanic dust in Barbadoes, of which a notice by Mr. O. W. Jeffs appeared in *Research* for April, is a well-remembered event in that island. Few of the present inhabitants were personal witnesses of it, but the dust is still sometimes found in the form of a dark grey layer when a pond is drained, and the material is always called "May dust," because it fell in the month of May, 1812.

The geological interest attaching to this fall of dust has been increased by the discovery of much older falls of volcanic dust in the same area. These were found by Prof. J. B. Harrison, F.G.S., and myself in the series of oceanic deposits which include the well-known Radiolarian earth for which Barbadoes is famous. These deposits are of the nature of oceanic ooze, and the layers of volcanic dust associated with them must consequently be due to eruptions which took place before the present island was raised from the bed of the ocean; they are probably of Pliocene or very early Pleistocene date.

Beds of fine grey pumiceous and felspathic dust occur in the lower part of the oceanic series near Consett's Bay and at Bissex Hill, and on a higher horizon on Melvin's Hill. Particles of the same volcanic materials are also scattered through some of the beds of Radiolarian earth, giving them a certain roughness and grittiness which the pure siliceous earths do not possess.

The whole series is finely developed on Mount Hillaby, which is the highest hill on the island, and rises to 1,105 feet above the sea. The hill-top consists of light grey and white Radiolarian earths with layers of dark grey volcanic mud, some of which are beautifully laminated; they vary a little in coarseness of texture, but are mostly in a very fine state of division.

Prof. J. B. Harrison, who was until recently Government Chemist in Barbadoes, made an analysis of one of these layers, and this I give below side by side with the analysis of the dust which fell in 1812, as given by Mr. Jeffs, and which proceeded from St. Vincent:—

	Grey Bed, Mt. Hillaby.	Volcanic Dust, 1812.
Silica	63·70	58·80
Alumina	16·55	20·44
Ferric Oxide	trace	7·36
Ferrous and Manganous Oxides	5·43	
Lime	7·59	6·75
Magnesia	1·57	2·38
Alkalis (Potash and Soda)	2·94	3·47
Water	2·23	·80
	100·00	100·00

It will be seen that the two analyses do not differ very widely, but it is possible that some of the lime in the Hillaby mud may be due to an admixture of calcareous organic material, and that its volcanic ingredients are more highly silicated than the dust thrown out by St. Vincent; examination by the microscope confirms this inference.

Miss C. A. Raisin, B.Sc., has kindly examined two samples of these grey earths—one about ten feet from the summit, and one five feet higher. Of the first she observes:—"The ground mass consists largely of very finely-disseminated argillaceous material, in minute films giving faint depolarization tints. The mineral fragments are often embedded in this ill-defined base. Many of these fragments, though broken, are definitely crystalline, and they suggest the characters of fine volcanic dust. Some the mineral is probably felspar, some mica."

Of the second, Miss Raisin says:—"This consists mainly of angular mineral fragments, but includes also a few pieces of pumice and some brownish spheres, which are possibly casts of Foraminifera, and a few well-defined Radiolarian fragments."

Having obtained from Mr. G. H. Hick a sample of the modern dust which he had had analysed, I sent it to Miss Raisin, who reports upon it as follows:—"The specimen of the dust which fell in 1812 is very interesting for comparison; it has a marked similarity to certain of the Barbadoes rocks, such as that from Mt. Hillaby (10 feet below top). The slides of both specimens exhibit angular crystalline fragments, many of which are broken crystals of well-preserved felspar, but the particles in the modern dust are perhaps larger on an average than in most of the older Barbadoes rocks, and include a fair abundance of a pale greenish pyroxenic mineral."

The existence of this pyroxenic mineral (? augite) and the absence of any organic matter in the modern dust is sufficient to account for the differences in the analyses. The material of the older dust showers was evidently more acidic than that of the newer, and the lava from which it was derived must have been a purely felspathic rock like saindine-trachyte, while the latter might be the dust of andesite. It would be interesting to know whether the Pliocene lavas of the West Indies are generally more acidic than those of more modern date.

A. J. JUKES BROWNE.

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Publications Received.

The Textile Mercury; Hybrid Rhododendrons, by Rev. G. Henslow, M.A.; *A Contribution to the Pterylography of Birds' Wings*, by W. P. Pycroft; *The Social Pioneer; Studies in Evolution and Biology*, by Alice Bodington (Elliot Stock); *Glimpses into Nature's Secrets*, by Edward A. Martin (Elliot Stock); *An Account of Some Diggings on the Site of an Ancient Village and Still More Ancient Burial Place, near Brassington, Derbyshire*, by John Ward (Bemrose & Sons, Lond.); *The Pleistocene Flora of Canada*, by Sir W. Dawson, F.G.S., and Prof. D. P. Penhallow, F.R.S.C.; *Alphabetical Index to the Collection of Minerals in Derby Public Museum*, by H. Arnold Bemrose, M.A., F.G.S.; *Proceedings of the Liverpool Naturalists' Field Club, 1889; Report of Professor J. Henry, Secretary of Smithsonian Institution, 1866-67-68-69-70-71-72-74-75-76; Textile Mercury*, vol ii., Nos. 40, 53, 54, 55, 56; *Johns Hopkins University Circular*, April; *Rambles and Reveries of a Naturalist*, by Rev. W. Spiers (London: Charles H. Kelly, Wesleyan Methodist Book-Room, 2, Castle St., City Road, E.C., and 66, Paternoster Row); *Label Lists of British Macro-lepidoptera and British Marine Shells* (Naturalists' Publishing Co., Birmingham). The following Publications for May:—*Optical Magic Lantern Journal and Photographic Enlarger; Assure; Naturalist; Civil Service Guardian and County Council Courier; Nature Notes; Natural History Journal and School Reporter; Arts Monthly;* and *Knowledge.*

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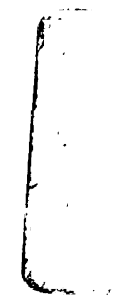

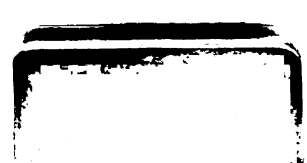

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